PROCEEDINGS

Eighty-Sixth Annual Conference

OF THE

American Railway
Bridge & Building Association

1981

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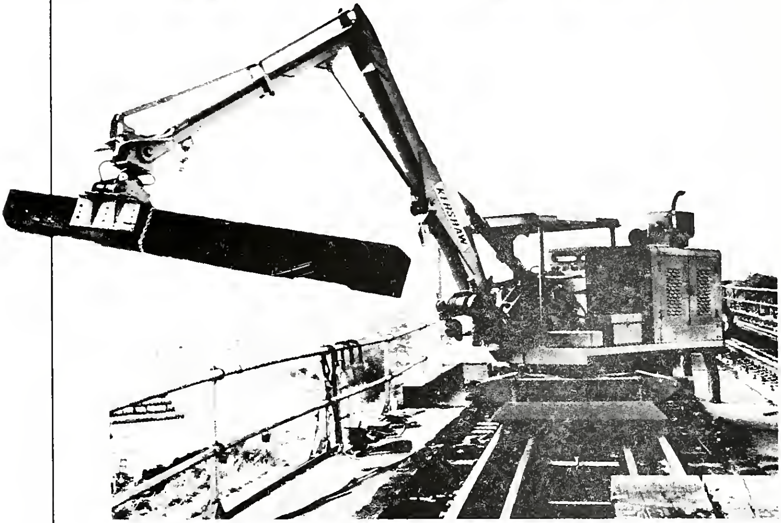
Bridge Crane



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Proceedings of the

Eighty-Sixth Annual Conference

of the

American Railway
Bridge & Building
Association

Held at

CHICAGO, ILLINOIS

September 14-16, 1981

Published by the Association
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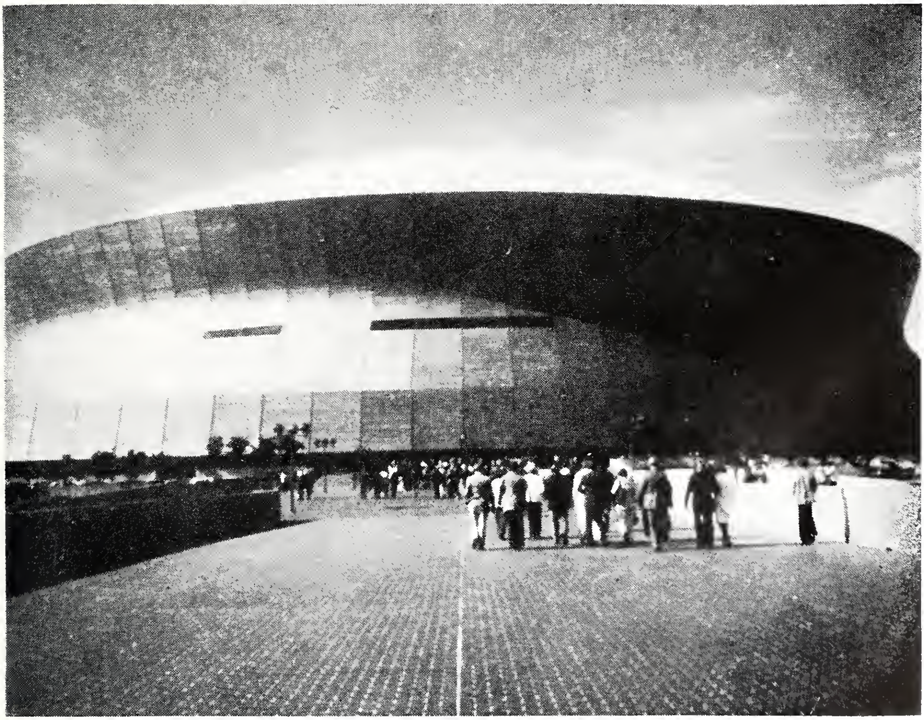
J. W. Chambers, Missouri Pacific........St. Louis, Mo.

1982 CONFERENCE

The 87th Annual Conference of the American Railway Bridge and Building Association will be held from October 4 through October 7, 1982 in New Orleans, Louisiana. This will be the fourth time the Association has held their meeting in New Orleans, having met there in 1895, 1916 and 1929. Headquarters hotel for the conference will be the Hyatt Regency New Orleans with the meetings being held in the New Orleans Superdome. The hotel and Superdome are accessible to each other by an elevated walkway. Both the hotel and Superdome are situated within an area of one square mile that includes the central business district, the French Quarter and the International River Center. Presiding at the meeting will be B&B President, W. R. Hyma, Bridge Engineer System, Santa Fe.

Hyatt Regency New Orleans, headquarters of REMSA '82. Partially shown is the Louisiana Superdome on the right.

New Orleans Union Passenger Terminal.



The Louisiana Superdome, site of REMSA '82, has a free-span roof of 9.7 acres and peaks at 27 stories above the 160 square foot arena floor. Shown is a concourse from the Hyatt Regency New Orleans, headquarters for REMSA '82.

MEMOIR

(1898-1981)

NEAL D. HOWARD

Neal D. Howard, retired executive secretary of the American Railway Engineering Association, and executive vice chairman, Engineering Division, Association of American Railroads, died in Honolulu, Hawaii, on September 25, at age 82. Mr. Howard, who had retired from these positions on July 31, 1964, moved to Honolulu from his home in Evanston, Illinois in September 1969.

Mr. Howard was a native of Rochester, New York, having been born there on December 23, 1898. He was graduated from Rensselaer Polytechnic Institute with a degree of Civil Engineer in 1922, and from July of that year until August 15, 1924, he was in the employ of the Illinois Central Railroad, at Carbondale, Illinois, during which period he was engaged in construction and maintenance of way work, including the making of performance studies of gang organizations and units of work equipment.

Having attracted the attention of the Simmons-Boardmen Publishing Corporation through his reports in equipment and performance studies, he went with that company in late August 1924, at Chicago, and continued in its employ until April 1950. Early in this period he was eastern engineering editor of Railway Age and Railway Engineering and Maintenance magazines at New York. Moving to Chicago in March 1938, he became engineering editor, Railway Age, and managing editor, Railway Engineering and Maintenance, and in October 1944 editor of Railway Engineering and Maintenance. In November 1946 he became also western editor of Railway Age. While serving in these latter capacities, he was also editor of the 1948 edition of Railway Engineering and Maintenance Cyclopedia.

On April 1, 1950, he left these three capacities to become executive secretary, American Railway Engineering Association, and executive vice chairman, Engineering Division, Association of American Railroads, at Chicago, which positions he relinquished with his retirement on July 31, 1964.

Mr. Howard was a past president and Honorary Member of the Maintenance of Way Club of Chicago; a past president and Honorary Member of the American Railway Bridge and Building Associations, and a past first vice president of the Roadmasters' and Maintenance of Way Association of America. He had been a registered professional Engineer in New York and Illinois.

Mr. Howard is survived by his wife, Whitney; a daughter, Mary, wife of William G. Foster of Honolulu; a brother, Horace; a sister, Mrs. Ruth Howard Hutchinson; and four grandchildren.

MEMOIR

L. C. WINKELHAUS

L. C. Winkelhaus, retired, assistant architect, Chicago and North Western Railway, died in December, 1980. He joined the association in 1934, served as treasurer from 1948 to 1963 and elected an honorary member in 1963.

MEMOIR

H. D. CURIE

H. D. Curie, retired master carpenter, Chessie System, died November 19, 1980. He became a member in 1942, served as President in 1960-1961 and was elected an honorary member in 1967.

1981-82
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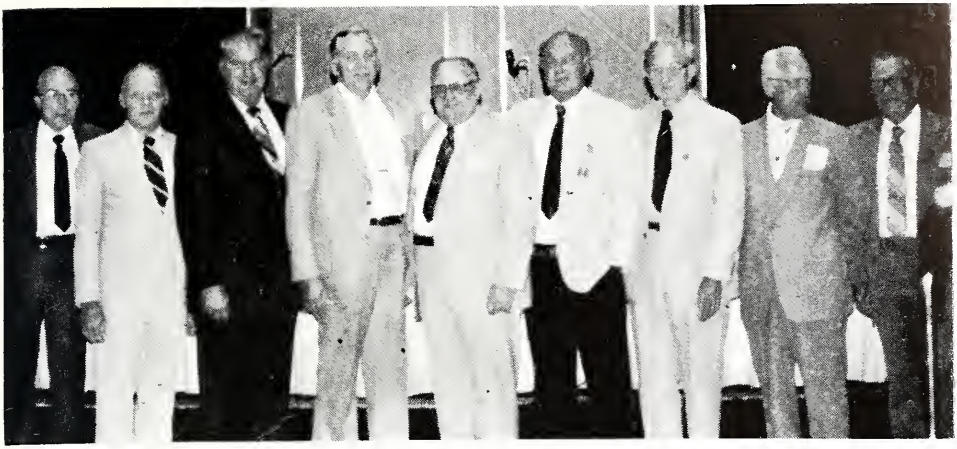

American Railway Bridge and Building Association Past Presidents—Left to Right: D. C. Gould, W. C. Sturm, J. R. Iwinski, W. H. Rankin, E. E. Runde, T. L. Fuller, W. F. Armstrong, R. D. Hellweg, H. M. Wilson.

PROCEEDINGS

REGISTRATION totaled 759 railroaders and 137 ladies.

September 14, 1981

The First Joint Session of the Roadmasters and Maintenance of Way Association and the American Railway Bridge & Building Association was called to order at the Hyatt Regency Chicago Hotel, Monday Morning, September 14, 1981 at 9:00 o'clock, Mr. B. D. Sorrels, President of the Roadmasters Association and District Engineer A.T. & S.F., Amarillo, Texas, presiding.

President Sorrels: As President of the Roadmasters and Maintenance of Way Association of America and on behalf of Mr. J. W. Chambers, President of the American Railway Bridge & Building Association, I declare this 93rd Annual Technical Conference of the Roadmasters and Maintenance of Way Association of America and the 86th Annual Conference of the American Railway Bridge & Building Association to be open in joint session.

It is proper that we pause to ask for Divine guidance and inspiration prior to commencing our Conference. I would like to introduce the Reverend LeRoy Cronkhite II, Pastor, Central Church of Chicago, who will deliver the Invocation. Reverend Cronkhite.

Reverend Cronkhite: Let us stand. Let us be in a spirit of prayer, as we pray.

O, Lord God, we come to you at the beginning of a significant experience, grateful for the lovely weather, the challenge and inspiration of a great experience, the renewing of friendship, and to all that is meaningful and worthwhile in life that can be shared with those of similar interests and concerns.

May your blessing be upon each one who is gathered here. Grant each one a most enjoyable experience, renewed strength and zest, and a safe journey home. May your presence undergird, guide, strengthen and lead all the decisions that are made during this conference, as we seek your guidance for each and every one. For this, we pray in His Name.

President Sorrels: Thank you, Reverend Cronkhite, for those words of inspiration. We would be pleased to have you to stay for all, or, for any part of our program but we know you have a busy schedule. Please feel free to leave whenever you desire.

I join President Chambers in welcoming you to this first session of the two Associations. We sincerely hope that you will enjoy your visit to Chicago and urge you to attend the sessions of this two and one-half day conference.

We encourage you to read your program carefully, as it is full of excellent topics. Enjoy yourselves and partake of the hospitality extended by REMSA.

For the ladies, we have an interesting program starting today with coffee during registration in the Water Tower Room, and, this afternoon, in the Water Tower Room a demonstration, "The Food Processor Phenomena."

Tomorrow the ladies will have a guided tour and a lunch at the Steak Joint.

I would like to introduce the Officers and Directors of the Roadmasters and Maintenance of Way Association, who are seated at the head table. Those whose duties demand their presence elsewhere will be introduced at a later session. Please withhold your applause until all have been introduced.

Mr. H. G. Webb, Director, Assistant Chief Engineer, Santa Fe.

Mr. R. E. Snyder, Director of Maintenance Operations, C. & N.W.

Mr. M. J. Marlow, Director, Supervisor of Engineering, Tracks and Property, E.J. & E.

Mr. Dave Staplin, Director of Planning, Family Lines.

Mr. C. D. Barton, Director, Engineer, Mo-Pac.

Mr. B. H. Price, Sr., Director, Development Engineer, B. & L.E.

Mr. Ray Hernandez, 2nd Vice President, Track Production Manager, Southern Pacific.

Mr. K. W. Sutherland, 1st Vice President, Superintendent, Maintenance of Way, System, C. P. Rail.

You may applaud. (Applause)

The remaining guests at the front table will be introduced at a later time.

I would now like to turn the rostrum over to President Chambers of the American Railway Bridge & Building Association. Mr. Chambers.

President Chambers: Thank you, President Sorrels.

It is a pleasure for me to join Mr. Sorrels in welcoming you to Chicago in the Joint Conference of our Associations. I cordially invite you to attend all the technical sessions of the conference because you will find them very interesting and enjoyable.

Now I would like to present to you some of the members of the Executive Committee of the Bridge & Building Association whose unselfish efforts have made this conference possible. Those whose duties are required elsewhere, we will introduce at tomorrow's session.

Will the gentlemen please stand as their names are called and remain standing until all have been introduced. Please withhold your applause until all have been introduced.

Beginning at my extreme left, Mr. D. C. Gould, our Immediate Past President. Don is Assistant Engineer of Structures, Union Pacific Railroad.

Mr. Paul H. Saletnik, Director, Assistant Engineer of Bridges, C. & N.W. He is not here.

Mr. Jim Michel, Director. Jim is Manager of Engineering Design, Amtrak.

Mr. Don Bessey, Director. Don is Assistant Chief Engineer, Structures, Chicago, Milwaukee, St. Paul & Pacific Railroad.

Mr. Jim Williams, Director. Jim is Supervisor Bridges & Buildings, E.J. & E. Railroad.

I guess Mr. Russell is not here.

Mr. J. W. Davidson, Director. Jim is Director of Bridge Engineering, BN.

Mr. O. C. Denz, Junior Vice President. Homer is Supervisor of Building

Maintenance, Chicago, Milwaukee, St. Paul & Pacific Railroad.

Mr. W. R. Hyma, Jr. Vice President. Walt is Bridge Engineer, Systems, A.T. & S.F. Railroad.

Mr. Ray McMaster, Senior Vice President of the Association. Ray is Manager of Facilities and Structures, B. & L.E. Railroad.

You may now applaud. (Applause)

Now I would like to introduce Mr. Glavin, President of the AREA. Mr. Glavin, do you have a few words?

Mr. Glavin: I got the message, Joe — "a few words."

President Chambers, President Sorrels, your respective Boards, Reverend Cronkhite, Mr. Cena, ladies and gentlemen:

It is certainly a pleasure for me to be here, and a great honor to represent the AREA and the Engineering Division of the AAR.

To give you an idea of some of the more significant projects in which these two organizations are presently engaged, the AREA is working with the Transportation Systems Center in Cambridge, Massachusetts, who are under contract with the Department of Transportation, the FRA, and a group is working with them to come up with Track Performance Standards. They hope these, some day, will supplant what we now know as the track safety standards. Rather than take an individual component and put it out for debate, we will take a look at the track and, if, the track is safe and performs as it should, then these will be the guidelines.

In the AAR we have a Committee that is working with the FRA to eliminate some of the present track safety standards, modify and update some of the others, and to make them more realistic.

These are exciting times. These are challenging times, for the roadmaster and B & B supervisor. Revenue freight traffic of the Class 1 railroads measured in ton miles, rose to a record high of 919 billion tons in 1980. This is five-tenths percent greater than the previous record year of 1979 and the increase since 1970 has been dramatic.

A great deal of this is attributable to unit trains, largely, unit trains of open-topped mineral freight in 100-ton cars.

In 1979, which is the latest figure we have made available for all the Class 1 railroads, we laid over one million miles of new rail, which is the highest amount of rail laid since 1953.

Also, in 1979, 26.7 million new crossties were installed. All this has been done in total trackage that is 11% less than it was ten years ago.

Now, to produce a track and bridge structure and serve the needs of the ever-increasing traffic requires the experience, knowledge and dedication of the maintenance-of-way, track and B & B people, such as are included in the membership here present. In concert, working with all of us, are the machinery and material supply people, represented by Mr. Coy and Mr. Gallagher. These people have worked ever so closely with us to develop a better and more effective product to meet our budgets and obtain the productivity of which the MW people have far surpassed all other departments in our industry.

The reports and presentations, and, I know the hard work that went into them, are to be presented at this conference so that you, the Roadmasters Association and the Bridge & Building Association, are equal to meeting that challenge. I wish you a productive and successful conference. Thank you. (Applause)

President Sorrels: Thank you, Bill.

The Railway Engineering Maintenance Suppliers Association has this year, as they have in the past, materially assisted our two Associations and without their support these conferences might not be possible. It is with pleasure that I present to you Mr. C. L. Coy, President of REMSA, and with the Tamper Division of the Cameron Corporation. Mr. Coy.

Mr. Coy: President Ben Sorrels and Joe Chambers, special guests, ladies and gentlemen:

It is a signal honor for me as President of REMSA to be asked to join in the welcome to you to the 93rd Annual Conference of the Roadmasters and the 86th Conference of the Bridge & Building Association.

I know that all members of REMSA join me in wishing you a very successful and productive 1981 meeting.

It is certainly important to note the longevity and the impact of the Roadmasters and Bridge and Building groups in the association field. It is very difficult to recall such continuity of service among other associations in other industries.

At this time I would like to present to Ben Sorrels REMSA's gold pin, which reads: "President — Roadmasters and Maintenance of Way Association of America — 1980-1981."

President Sorrels: Thank you, Mr. Coy.

Mr. Coy: Also, to Joe Chambers, I would like to present on behalf of our membership a matching pin, which reads: "President — American Railway Bridge & Building Association — 1980-1981."

President Chambers: Thank you, Mr. Coy.

Mr. Coy: We hope your stay in Chicago will be pleasant. The Officers and Directors of REMSA are at your call. Anything we can do to make your stay more enjoyable and problem free, please do not hesitate to call us for help.

We know that many of you are looking forward to the Annual Banquet on Tuesday evening in the Regency Ballroom. You will hear more about the entertainment shortly. Thank you very much. (Applause)

President Sorrels: Thank you, Mr. Coy.

Another friend of our Associations is Mr. W. J. Gallagher, 1st Vice President of REMSA and with the Sperry Rail Service. Mr. Gallagher.

Mr. Gallagher: President Sorrels, President Chambers, special guests, ladies and gentlemen:

Again, it is REMSA's pleasure to hold its Annual Banquet for the Roadmasters and Bridge & Building Associations in connection with their annual Joint Conference. It will be held in the Regency Ballroom on Tuesday evening, September 15th. The doors will be open at 6:30. Dinner will be served at 7:00.

A musical trio will greet you at the door. This will be followed by a dinner and a fast-pace program of entertainment. We sincerely hope that the festivities can be concluded in time to permit you all some time Tuesday evening to visit with your friends and suppliers.

Benny Sharp will be with us again. As you know, he is an old friend of the railroads and has been a fixture at this annual event for some time. He will again be in charge of the entertainment, with Max Cooper, a comedian and impressionist, as headliner, and Joyce Rice, featuring an outstanding western act. Benny will head the Sharp Band and I am sure you will enjoy the show.

The same ticket arrangement will prevail, as it has for the many years REMSA has had the pleasure of being host for this affair. All registered railroad men and their wives will be provided with complimentary tickets. We sincerely hope that those of you who cannot be with us because of time or other commitments will forego requesting a ticket, as suggested by the Roadmasters and Bridge & Building Associations in their recent Newsletters.

We certainly hope you can be with us and we are sure you will have a good time. Thank you. (Applause)

President Sorrels: Thank you, Mr. Gallagher. We have always enjoyed the annual banquet, which has always been a very nice affair. If any of you are attending this banquet for the first time, you are in for a real treat.

Our Keynote Speaker during this 86th Annual Conference of the American Railway Bridge & Building Association and the 93rd Roadmasters Association Conference is Mr. Cena, President of the Santa Fe Railroad. I am sure you all know his credentials, since they have appeared in the many railroad periodicals during the last few years. I am not going to give them to you again. I would rather introduce him in a different manner, that being as the boss whom we on the Santa Fe Maintenance of Way and the B & B Departments know. That is, the man who has led us to the track, bridge and structure condition that we are in today that, I might say, is excellent.

Mr. Cena over the past number of years has provided us with the funds to upgrade our railroad to its present condition, once we had proved to him our needs under the leadership of our Chief Engineer, Mr. Autrey.

Now I do not want to make this chore sound too easy. Mr. Cena has always demanded a very complete program of our maintenance and capital expenditures in the most intricate detail. He has also demanded the economic, proficient and quality completion of these projects. Otherwise, in roadmaster type language, he makes us prove what we need, provides us with the funds to do it and watches to see that it gets done. If we did not, you can be assured he would notice and you can also be assured that we would either be told directly or indirectly that we failed to accomplish the job. Being told is usually directly because Mr. Cena is on the Railroad a great deal. But, with Mr. Cena, we can be assured, if the job was done as predicted and with quality, you would hear compliments. Mr. Cena. (Applause)

Keynote Address

By L. CENA

President, Santa Fe, Chicago, Illinois

Thank you very much, Ben. I am always delighted to be introduced by a Santa Fe person with whom I have worked for many years. I have bounced around the railroad quite a bit in a number of locations, two or three times here in Chicago and out on line. Also, a number of very familiar faces are in the audience. It is always delightful to be able to address the most important group on the railroad.

I was extremely pleased when Bud Price recently asked me to participate in your meeting, for a couple of reasons:

First, I think the members of your organization have one of the most important jobs on the railroad. I welcome the opportunity to share with you my thoughts on the problems and opportunities associated with your work.

Secondly, I was also just plain flattered that you chose me to be your speaker. Many movers and shakers in

L. Cena

the railroad industry are heard of today. People are pasting together big mergers, people are reviving troubled properties, people are trying to dispose of properties that did not make it, so I want to thank you for the courtesy you have extended to me to take on this task.

Webster says a keynote address is one designed to arouse unity and enthusiasm. I do not know whether my comments will accomplish this or not, because I am really not going to take the usual approach of reciting statistics about the great job you have been doing. The temptation is great to point with pride to our thousands of miles of welded rail, to our sophisticated array of tampers, liners and similar tools, to improvements in productivity over the past couple of decades, and to the stronger track and roadbed we have today. All of these things are ample evidence that you have been doing a good job.

Railroads Can Accomplish More

However, I really did not come here to build up your ego. I may even deflate it a little bit, because the main point I want to make today is that I am a long way from satisfied with what has been accomplished so far.

As Bill Autrey would probably be quick to tell you, I am never satisfied. Even if a job is 99% perfect, I believe we should still keep striving for that one per cent, because the minute you sit back with a satisfied smile on your face, you stop making progress. I am fairly convinced room for much more progress in our maintenance-of-way activities can be made.

If I may take the liberty of paraphrasing Sir Winston Churchill, what we really have accomplished so far with our mechanized maintenance is not the end of progress. It is not even the beginning of the end. It is only the end of the beginning. Now comes the tough part — where do we go from here?

It might be worth asking whether those of us intimately involved in railroad maintenance are capable of making a giant step in progress. While experience can be very helpful to a person, it can also imprison you.

How does it happen canal builders did not develop the railroad? Why is it that it was not a soap company that thought up nylon? Why did not the Telegraph Company think up the telephone? They were all victims of their own experience.

A Fresh Look Needed

It is not easy for any of us to stand far back from a problem with which we are closely involved and take a fresh look. We are so busy solving our day-to-day problems with the tools currently at our disposal and refining those tools, that we seldom have time to consider whether we should be spending some time designing a completely new set of tools.

If we are to survive and prosper, we must take a fresh look. When I say "we," I mean each one of us. We cannot rely upon our sophisticated equipment or our research and development labs to solve these problems for us. Those things are very useful and very productive, but before we can put them to work, someone has to have an idea. Someone needs to conceive of the solution before it can be developed into a practical application.

General Motors had an inventive genius by the name of Charles Kettering. I am sure you have all heard of him. He once said, "A problem is not solved in the laboratories. It is solved in some fellow's head."

I might as well tell you I did not come here today with any specific solutions. I am sort of like Will Rogers when he was discussing the German U-boat menace in World War I. Mr. Rogers suggested that the way to solve that problem was to heat the water in the Atlantic to the point where it became impossible to remain submerged. When someone asked him how he could do that, he replied that he just came up with the ideas and it was up to someone else to implement them.

So, like Mr. Rogers, I do have a few ideas about what needs to be done. How to accomplish it, I will leave to you.

Track Occupancy

First, let us talk about track occupancy. When you folk are out there working on the track, obviously, the Operating Department cannot work trains over it. That causes us much of a problem right today. But, consider for a moment that our industry has seen a 22% increase in revenue-ton-miles from 1975 to 1980. Although 1981 is a recession year, and, probably, little or no growth will come this year we have no doubt, whatsoever, that the combination of the energy problem, deregulation and an expanding economy is going to produce dramatic growth over the next couple of decades. That suggests a tremendous challenge for you.

If we have a problem today with track occupancy, what is it going to be like in 1990 if our traffic is 30% or 40% greater? If we are still doing things the same old way, I will tell you what it is going to be like. It is going to be intolerable. Unlike Will Rogers, I also have the solution. All you really need to do is develop a new breed of maintenance equipment that does not occupy the track, or, at least, occupies it for a minimal amount of time. Make it easier for maintenance crews to co-exist with train operations and I will guarantee you your efforts will be well rewarded.

New Materials and Equipment Needed

What about materials? It is no secret to any of you that we are bumping up against the ability of current materials to withstand present day wheel loads. What are we going to do about that? The likelihood of turning back the clock to days when we had smaller cars with lighter loads is almost non-existent. As indicated a few minutes ago, traffic is going to increase dramatically. That means the only practical solution is to improve the reliability of materials we use and the manner in which we use them.

What I am saying is, when we recondition a track, we have to do it much, much better and make it last longer.

Representatives of railway supply companies are here today and I do not wish to offend any of them for we regard you as our friends and allies. We appreciate the strides you have made in maintenance-of-way equipment and materials over the years. But, with all due respect, I believe part of the job for railroad officers is to keep you suppliers uncomfortable. Why should a supplier be interested in developing a completely new piece of equipment when railroads are content to buy last year's model that has been slightly improved? Do not get me wrong — I am happy about the evolutionary changes. But, I think, we are at a point now where we need the next generation of revolutionary changes.

I will just remind you railroad officers of what happened in the automotive industry. Detroit was content to keep turning out the same gasoline-guzzling autos year after year, as long as the consuming public was willing to pay for them. I believe they would like to be doing it yet today, because making drastic changes does not come cheaply. But, when the consumer used their check books to demonstrate they wanted the economical models being produced in Europe and Japan, Detroit really heard the message, and, perhaps, too late, in some instances.

Those of us in the railroad industry must get the same message across to our suppliers. We do not want to keep buying last year's model with minor improvements. We want a new approach that will solve the problems of track occupancy and product reliability.

Railroad Officers Must Help

I do not want to leave the impression here that we are looking solely to suppliers to come up with the solution. Railroad officers will not have done their job if, like Will Rogers, we simply deliver to our suppliers the message that we need a better system and then sit back content. I ask each one of you in this audience to think about change, think about what you need to do your job better, and continue to share your ideas, as you will be doing here this week.

The advice of a fellow by the name of Daniel Burnham, who was a well known Chicago architect of the early 1900's, would be very applicable to our problem. Although he was giving his advice to a planning commission, I think it still is outstanding. Burnham's advice was — "Make no little plans. They have no magic to stir men's blood and probably themselves will not be realized." That is the kind of thinking we need in the railroad industry. Yes, we need people who are content to follow a set routine and get the job done, but I will create one hundred of them for one person who manages to find time now and then to stare out the window and come up with new ideas. Someone is needed who makes big plans, even though many of them may never be realized. That planning must involve more than just new methods and new materials. It must also involve people.

Obviously, we must be sure that we have trained people, well qualified people, but I am talking about something else. I am talking about involving all our people in the planning and decision-making process. And I am also talking about listening, really listening, listening to what they have to say.

I read recently about a situation some years ago involving Proctor & Gamble. One of their workers forgot to turn his soap blending machine off one day when he went to lunch. When he came back, he noticed that the resulting batch had tiny air bubbles beaten into it. That sparked his imagination and he finally found a supervisor who thought his idea was worth a try.

Since then, Proctor & Gamble have sold more than thirty billion bars of Ivory soap. You know, the one that floats, only because one worker saw something of promise in air bubbles.

I can just imagine what greeted this fellow when he first voiced his idea of selling bubbles. But, somebody took time to listen, and I suspect that neither of them has been sorry since.

I do not imagine anyone can convince you or me that putting air bubbles in our steel will make rails any stronger or that we could profit by soaping the spikes so they will drive easier. But, just as sure as I am standing here, someone who works for everyone has an idea that would solve, at least, some of our problems. My advice to you, as a manager of people, is — listen. Ideas are where you find them.

We at Santa Fe have obtained some ideas about building a new generation of containers from a man who builds boats. We have listened to someone who manufactures steel tubing about a possible improvement in grain handling equipment. We are working very closely with someone from the automotive industry in an effort to improve aerodynamics. Some of these may be dead leaves, but others may lead to progress.

Enthusiasm and Curiosity Ingredients for Progress

The two main ingredients for progress, in my opinion, are enthusiasm and curiosity. When you combine them, occasionally something else happens and that strange thing we call serendipity. I have a hard time pronouncing that but I surely do not have a hard time recognizing it. In case you have forgotten, serendipity is the gift of finding something valuable that you were not seeking. For example, legend has it that glass was discovered by a pair of Phoenicians who piled up some stones to support their cooking vessels. The combination of fire, sand and the stones they used with heat applied produced a form of glass.

I read recently where Monsanto discovered an important herbicide while studying a rubber processing chemical.

Each of you can probably remember something you discovered while looking for something else. If you are going to be progressive, if you are going to be enthusiastic, and if you are going to be curious, sometimes you have to be a maverick and that "ain't" easy. People are uncomfortable around non-conformists. It becomes even more uncomfortable for the rebel when his ideas fail. After Winston Churchill saw the British safely through World War II, they showed him their appreciation by turning him out of office. His wife told him that defeat might be a blessing in disguise, to which he replied, "At the moment it seems quite effectively disguised."

When an old Thomas Edison was trying to develop the light bulb, he tried twelve hundred materials for the filament and none of them worked. One of his associates suggested to Mr. Edison that he must be very disappointed to have failed twelve hundred times. "I have not failed," replied Edison. "I have only discovered twelve hundred things that will not work."

At least twelve hundred things will not work as we endeavor to improve our maintenance procedures. Perhaps some of you have thought of that many, or more, already. But, do not be discouraged. The railroad needs you as we have never needed you before. We can have the best marketing departments in the world, we can have the strongest motive power, and we can have the most dedicated employees, but if those tracks do not do the job, we have lost the ballgame. I am betting that we are going to win and I encourage you to again sit back and take a new look at your problems. Expand your curiosity and, of all things, retain your enthusiasm.

The Best Is Yet To Come

I have told everyone I know that the best is yet to come for the railroad industry. I am counting on you to prove me to be correct. The meeting here this week is a good place for you all to start. I wish you luck in your meeting and success in your endeavors at home. Thank you very much. (Applause)

President Sorrels: Thank you, Mr. Cena. You have provided us with an excellent keynote foundation for our meeting this week. You are welcome to remain for all or any part of our program, but should your schedule demand your presence elsewhere, please feel free to leave.

One of our most demanding positions on our Board of Direction is that of Program Chairman. Mr. B. H. Price has performed very well in this capacity for the past year. I would like to call on Mr. Price to introduce our next speaker.

Mr. Price: Bill Gearhart attended Virginia Polytechnic Institute.

He served with the United States Army in both World War II and Korea.

He has been a railroader since 1941, working as a Roadmaster, Bridge and Building Supervisor, Trainmaster, Assistant Superintendent on the Norfolk & Western.

Mr. Gearhart is currently General Manager of Safety for the N & W.

His talk this morning will be directed towards first line supervisors and the responsibility of these people for the safety of the employees of the railroad. Mr. Gearhart.

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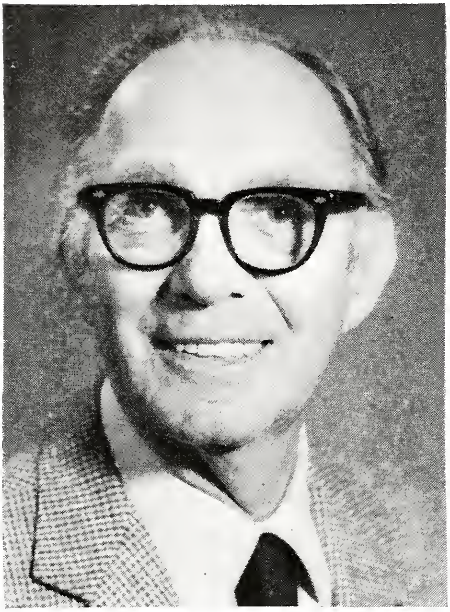
Railroad Safety

By GEORGE M. GEARHART

General Manager Safety, Norfolk & Western, Roanoke, Virginia



George M. Gearhart

Good morning!

I see we have a couple of extra minutes in our schedule. Why not take this time for everybody stand up to stretch for a couple of minutes. Let us do that right now.

Now, I do not intend for you to leave the room on that stretch, but just to stand up to stretch. All right, let us go.

You know, it is really great to be here with you folk today and a real honor to be on this program. When I saw Mr. Cena was going to be on the program ahead of me, I said, "Oh, oh — I have problems because if any man believes in safety — he is it." We on the Norfolk & Western have watched what has happened on the Santa Fe since he became Vice President of Operations and then moved on ahead to become President of the Railway, and, we do stand in awe of the way Santa Fe has moved right on up there and keeps going up and getting those Harriman Awards year after year. This is great, Mr. Cena, and we really envy you.

As I say, it is a real pleasure to be here with you today. When Bud Price invited me, I jumped at the chance. You ought never to ask a safety man to make a talk, because he usually has a few notes in his pocket and he is right ready to jump up to say something about it. But, having been in maintenance-of-way work for quite a few years, I really do think it is great to come up here to talk to you people. Knowing about all the daily frustrations that you have, never having big enough budget, always getting more directions than you really need, getting called out early, getting home late, being the first to the derailment and the last ones to leave, can be awfully frustrating.

Satisfaction Comes from Job Well Done

On the other hand, no greater satisfaction can come than looking over a stretch of track that has been surfaced and tied just right. You get up there to look down to see that nice line through there and it does something to you. Or, fitting a turnout in just right when everything just fits, leads and all, or placing a steel span that fits just right on those anchor bolts; widening out a rock cut so that the operating people can handle wider loads; or taking the form off a concrete job and seeing a real nice smooth finish, with no air holes in it, yes, these things do give you a very great satisfaction. Replacing worn jointed rail with ribbon rail, to really see the results of your planning and your supervision, I just do not think you get that feeling anywhere else, excepting in your maintenance-of-way work. You should take pride in what you are doing. As Mr. Cena has said, you are the backbone of the railways. Without the tracks, we do not run our trains very far.

The Old Time Way

Back in 1941, I took my first job on the railroad. It was a good job. I was hired as a laborer on a track gang, down in a little place called Roanoke, Virginia. The pay was good — I got 41½¢ an hour. If I worked every day, six days a week, I could make right at $80 a month. This was great! We received a raise that year for they raised our pay to 45¢ an hour!

I remember that first day. The first thing I was given a physical. Then I went to the office and filled out some papers. Then a clerk gave me a rule book and told me to get out there with the foreman. I reported to the foreman and he put me to work. I read my rule book that night.

Now that was pretty much the way things were handled back then. And, you know, people just did not get hurt. When they did get hurt — they kept on working, anyway. It really had to be a serious accident before anyone even thought about getting off on account of an injury.

Do you believe that? Do you believe what I just told you is right? We hear this from the old timers a lot. What I said about my first day — that was true, but, that next remark I made about people not getting hurt — that was not true. People did get hurt back then. But, we had some good budgets and we could stand a few extra hands around. We could always use a little extra help on the cook car, or around the tool house, grinding tools. And, of course, the reporting rules with which we kept score were different back in those days. You counted only the lost time injuries if they lost over three days in the first ten days after it happened. If you could keep them going some way or other for that first ten days, then they could fall over on their faces and it was "O.K." — you did not have to count them.

To be a fatality, you had to die within the first twenty-four hours after the incident happened. If the injured person made it past the first twenty-four hours, he was just counted along with the bruised pinkies and the other things.

When I started out, back in 1941, the biggest piece of equipment we had to work with was what we called an Eagle crane. In fact, it was the only piece of equipment we had, besides the track motor cars, rail drills and bolt machines, and air compressors. We did about everything back then with manual labor. On double-track main lines we would have a section gang for every six to eight miles. On single track we had a gang for about every ten to twelve miles. When I was an assistant roadmaster, I had a two hundred mile district and on this district I had fourteen main line sections and eleven branch line sections — twenty-five sections. Years later, when I returned to that same district as a roadmaster, we had been reduced to ten main line sections and six branch line sections — but still had sixteen gangs out there.

When I left that job, we were operating with two branch-line sections and seven main-line sections. Since I have left that job, in the years since then, the reduction is to three section gangs looking after the whole territory.

Yes, things have changed — things have changed quite a bit. You people are working in a whole new world from the one in which I started. However, one thing has remained the same — if an employee is not trained to do the job right, if the supervisor does not show a real interest in having employees trained right, accidents and injuries will occur.

Now, I realize that this may sound like ancient history to you. I keep dwelling on the fact that I started off forty years ago. But, really, to me it does not seem too long. As I said, I can remember that first day. It really seems like it was just yesterday when I started out.

Now, as I said, first, I had to go to see that doctor. He sent me back to the office — said I was "O.K." Then we filled out those papers — and then I was told to get on out with the gang. Yes, the clerk did hand me the rule book. He told me to read it the first chance I had. I went on out and went to work.

Does that sound familiar to any of you here? I did not know from "nothing" — but there I was, out there on the gang. I did not have a pair of work gloves but, I did have on a real good pair of canvas tennis shoes — and no one said a word about that, either. Not a soul took exception to the fact that here I was, going to work that day.

What Are We Doing Today?

Now, how much differently are you treating newly hired employees today? How much time do you actually spend seeing to it that these new people get started off right? I am not talking about what they are supposed to be doing. I am talking about what they are actually doing. What is really happening?

You know, things have changed. Mr. Cena talked about it earlier this morning, about all the new machinery we have to help us, and I will bet that when you get a new piece of machinery on your railroad, on your region, or on your division or district, either you or some of your supervisors are right on hand when it arrived, and you make certain it is unloaded properly, you make certain the mechanics see that it is serviced properly, you make certain a qualified operator is on hand to handle this expensive piece of equipment, and you surely do not put it out on the main line without proper protection.

All that makes sense. You have a big investment in that machine. If anything happens to it, it is going to cost a great deal of money to get it repaired. The cost may run up into the thousands, and besides that, you need it to get the job done.

Employees Important

Now, let us talk about your employees. Have you any idea how important they are to your work? Have you ever had a machine that was idle because the operator did not show up? Have you ever actually tried to get along without any employees?

Yes, your employees are important to you. When they get hurt, they can be mighty expensive. Have you priced the cost of a broken leg lately, or a sprained back? If you think the mechanical machine needs protection because it is expensive when it breaks down, then you remember this — your human machine, your employees, can be just as expensive, or more so, when you let them break down.

What Is Safety?

Now, if you have listened closely to what I have said — up to this point I have not mentioned the word "safety." I did that for a definite reason, because "safety" to a number of people is a word that turns them "off." Think about it. Just think about that word "safety." We use it in describing certain things that can happen in a football game — and what is a "safety" in a football game? That is when the player gets caught behind his own goal line and it costs. It costs a couple of points and the team does not even get to keep the ball.

Then, all you people who are hunters, on any kind of fire arms, what is the "safety"? That is the device that keeps it from working.

In design work, when you are designing a bridge, or a truck, or anything such as that, for certain loads, you design it for its purpose, and then you add a "safety" factor. The design is made even stronger than is really needed because you have to prepare for the unknown. You never know what type strains to which it may be subjected, so, in any design work we always add a "safety" factor. This is because we do not know what is going to happen. Actually, we over-design, and, actually, instead of calling this a "safety" factor, what we ought to call it is an "ignorant" factor. But instead, we have tacked that word "safety" on it.

Too Many Use Safety The Wrong Way

I am afraid that too many of us are inclined to use that word "safety" the wrong way, and we think about it as something that delays our work rather than something that is a necessary, integral part of anything done correctly.

Now, that is going to be my message to you here today. I want to give you some new directions and open up some fresh ideas for you to take home and put to work.

Did you ever stop to think that what you see in your employees and their actions is you? Think about it. Your employees and what they do are a reflection of you. If you are all for doing the job right, they will do it that way. They will do it right. If you will tolerate sloppy work, they will ease off and they will give you less than their best. If you insist on your employees being properly trained — they will be. If you think "safety" is important — so will they. But if you think "safety" is something to be tolerated if you have time for it — so will they. If you do not know and obey the rules and set the good example — they will not.

You can rather well figure the employees will listen to your words but they will get the real message from what you are doing — and they will do the same. That is why it is so important for every person in this room to understand exactly what "safety" is.

Recently, I was called upon to help organize a safety program for another property. It was not even a railroad. They were neighbors of ours and they asked me to come over to get something going. They had some bad accidents. Well, we gathered a group of the employees together and the first thing I did was to ask them to give me their ideas of just what is "safety." After a little while one man said, "Well, 'safety' means not to get hurt." We sat around a little longer and then another man said he thought "safety" meant to be careful. After that, a very long pause, followed, I guess, because everyone else had come up with the only things to be said and nothing more could be said on the subject. Finally, one man did stand up to say he guessed the best definition for "safety" should be "doing the job right."

Is not that great? Four words — but it says it all, "doing the job right."

Doing The Job Right

Sometime back I had a supervisor tell me one day, "I believe in safety — but," he said, "you know, we have to get this job done out here, too." Ever hear that? "I think safety is great — but I have to get this job done first."

How does that kind of thinking fit in with those four words, "doing the job right?" They do not — not at all. What this man was really telling me was that he did not really know what safety is all about. He had safety mixed up with what is not safety. Safety is not working really slow so you will not get anybody hurt. That is inefficiency — and safety has nothing to do with inefficiency.

Safety is not working two men when you need only one, to make sure no one strains himself. That is just plain stupid. I will tell you, if you do much of that your replacement will have a few things to say to straighten out when he gets there. We cannot afford that kind of activity in this day and time.

Safety is not — and get this — safety is not avoiding shortcuts. If you have a better, more efficient way to do something, do it, but make sure that it is a better and more efficient way that will get the job done and done right. But if it is full of chance-taking and things go wrong, that is not a shortcut. That is inefficiency.

Why is it when you do things on the spur of the moment that you have to go around to do it over again because something went wrong the first time — that is certainly not what we are talking about. That is just plain inefficiency.

If you do not get anything else out of what I am talking about here today, that is just it. Do the job right. You know, you do not go out there to lay continuous welded rail without having a good ballast section, and proper rail anchors on them. You do not pour a new bridge pier today and take the seal off the false work tomorrow, either. You wait until it is cured out properly.

You would not take a rail out of the track without having proper protection against all train movements. That is what we are talking about — doing the job right. That is all safety is. Once you are convinced of that, your people will be, too, because, as I said earlier, what you see in your employees is exactly what they see in you. If you are convinced that doing the job right is important, so will they, and they will do it that way — but you must be convinced yourself. You have to be full of this idea.

The old saying that a cup will not overflow until it is filled up itself is certainly true. Really, being a dedicated supervisor means you must want to see your people are doing the job right.

Employees To Feel You Want Job Done Right

While we are talking about setting the example — let us also talk about being the boss. Now I know what I respect in my superiors. I know that I expect them to correct me when I have done something not quite right. I know it means a great deal to me when I understand it is what my boss wants done, what he is talking about, and not just something that he has been told to tell me. When someone tells me that I should do something because Mr. So and So said to do it, I consider that person to be a messenger boy bringing me instructions from Mr. So and So. The same thing applies to you when you are giving instructions to your people. You want them to do what is right because this is what you have said, not because the Safety Director or someone else said to do it that way. If you really want to limit your authority over your employees, try that for a while.

We have had some people try that. You know the type. I am sure you know the type. "I am really a good fellow, myself. This is not my idea, but this is what Mr. So and So said we have to do." You do very much of that and pretty soon the employees will all be looking over your shoulder to see who this Mr. So and So really is, who the boss really is who is sending these messages out to them through you.

Let me give you a really good example. Last year on the Norfolk & Western we looked at our injury experience and we recognized we were having entirely too many eye injuries. We were having things happen to our people because they did not have their eye protectors in place. When we checked up on our people, we found that we had many employees who performed little jobs that required eye protection, but they left the protection back on the camp cars, over on the truck or back in the locker, and went ahead to do the job without them. We decided it was time to change our policy.

We decided in addition to our rules requiring that eye protection be in place for all these jobs that were actually specified in our safety rules, we would also require that anyone whose work required they had on a hard hat, also must have their eye protection on while they had on that hard hat. A pretty simple rule. If you wear a hard hat — have on your eye protection. It is a good program.

The first thing we did, we talked to all the General Chairmen on the system about it. We explained to them what we were going to be doing. We explained about the high number of serious eye injuries we had been experiencing in our maintenance-of-way and motive car people and while we felt it necessary to do this, to give our employees better protection, to save those eyes. These people were great. They listened closely.

Now they did not give us any endorsement to this idea, but, at least, they did not rear up and raise objections.

During our fall series of Supervisors' meetings, we talked to all the Supervisors all over the system, telling them about this program that was going into effect the first of December. We told them to talk to all our people to get this program going. We cautioned everyone to make sure they had plenty of eye protection on hand and to explain to their employees why we were getting involved in this problem.

Be The Boss

The day came when the new program went into effect — December 1st — and, in just about all locations, it went over with no problems at all. In some locations "all hell broke loose." My telephone started ringing — the telephones in the Department started ringing. Employees were calling in — employees who had been referred to the Safety Department by their Supervisors. The ones I answered, I would ask, "Have you discussed this with your Supervisor?" The answer they came back with was, "Yes, I have — and he agrees with me, it is no good!"

Then, we would have a really nice discussion about this safety measure on the telephone. They listened when we explained it to them. I told them all, "give this thing two weeks and then let us talk about it again, if you are still not convinced."

I had one man call me in less than a week. He said, "I do not have to wait two weeks. You are right, Captain. It takes a little getting used to — but it works."

I met some really nice people during this time. These were really nice employees whose supervisors had acted as messenger boys and let me do their job for them. But, you know something, we did not find an employee who did not listen, as we explained what we were doing. After the first couple of weeks, things settled down.

Do you know what we have done on the Norfolk & Western? We have reduced our maintenance-of-way eye injuries 80%. Our motive power injuries have been reduced 48%. We did not get the big reduction there because we did not have the bad experience with which to start. Most of our motive power people had their goggles a little bit closer. We found out we had many people who were not using that eye protection. We have not lost an eye since we started this program and we were averaging two or three per year.

Now I know some of you railroads have not had that sort of experience, but we did. Since we started this program, we washed that out. We have not had a lost time eye injury among our maintenance-of-way employees since the program started.

I could spend another hour just talking about this program and how great it is, but the point I really want to get across to you, the point I wanted to bring to your attention, is about those employees who were so upset and now they have come back to tell us in the Safety Department what a great program this is that the Safety Department started. This helps our ego. It is fine. But would not it have been much better if the employees had felt it was something their supervisors had done for them, instead of feeling this was something the Safety Department did?

The supervisors had told them earlier, "This is not my idea. I am just a messenger boy telling you what that safety bunch is making us do." Be the boss, as far as your employees are concerned. You are management, as far as they are concerned. Once management has given you directions in what it wants you to do, it should be your idea from that point on as far as your people are concerned.

Employees To Be Trained

Now, in addition to having the necessary equipment, doing the job right requires that your employees have training. It requires training of the new employees and re-training of the older employees. As I tell our people, "If you do not tell the people how to do the job right, they are going to learn it from someone and it just might not be the right way. Sometimes after you have shown the employees the right way, sometimes the old heads will say, "That is the way the boss says, but that is not the way we do it out here in the field." It is important to check on the old heads, too, from time to time. You can call it retraining, or, whatever, but do not ever expect your people to keep on doing things the way you start them out, unless you follow up from time to time to make sure they do.

We have found that it is a good policy when you are starting up a gang to, at least, spend that whole first day with that gang, not in trying to lay rail or get in ties, but just talking about work procedures and safety — the whole bit. Safety rules. Spend it. Let them realize this is important. Even if it is a gang of experienced workers to whom you are talking. This is good. It pays off.

On our particular road we take advantage of quite a few slide cassette presentations we have.

Just about all our divisions and terminals have what we call Caramate Slide Projectors. You can carry them anywhere, as long as you can plug them in to put on your show. They are great for helping people see what you want them to do.

We also have a short training manual we give all our new maintenance-of-way employees, in addition to the Safety Rule Books. This is really basic and it gives the new employees some good first-day advice. It covers such things as proper clothing, head protection, eye protection, safety rules, basic track tools. We even talk about what a spike maul is, crowbars, lining bars, a track jack, rail and tie tongs.

Of course, this does not replace the verbal instructions we expect the supervisors to give them that first day. It does not replace their regular Safety Rule Books. But, it gives them a good, quick reference to some of the information they should be expected to know "right off the bat." This is training. This is getting them started off right. But, as I said, earlier, you have to check on the old heads, too.

It was amazing, when we came out with these Manuals, how many of the old heads wanted a copy of it, also, to get some of the basics that they really had glossed over.

This business of training and following up on your people, is something you can never stop. It is kind of like the way the old farmer talked about milking the cow. You can do a darned good job today and get every drop, but the same job is staring at you tomorrow. It is a repeating job from which you cannot get away.

Any time you are with your employees, you must watch to see that they are doing the job right. You have to pay attention to what is going on. As I said earlier, your people are a reflection of you. If you are around them and do not observe an unsafe act, an unsafe practice, and if you do not correct it, you have a problem, because you can pretty well figure that your people did notice that you did not see what was going on. They just want to assume you are on top of everything that is happening and as far as you are concerned, it is "O.K." Do not get so wrapped up in a conversation with one individual when you are out around a gang that you overlook what is going on. If you do have something that is so important to talk about to one person that you cannot watch what is going on, get off to the side, where it is obvious you really are not watching what they are doing. You can pay full attention to the subject at hand, then, when you get back with that gang, you watch. See what they are doing. You will be amazed if you really watch. See how they are lifting; see how they are handling things.

Just recently, we had a gang in the paint crew, we had a man to sprain his back. He was carrying a big drum of gas all by himself. When we checked into it, the first thing the foreman said was, "I do not have enough men. If I had more men, this would not happen." What we found, though, was that one man was handling the drum and three others were standing there watching him.

This is what I am talking about. Use those people you have to full advantage and avoid these things. See that they are trained properly.

Keep A Record

You know; it is also very important in this training to keep a record of what you are doing. Instructing and counseling are great, but if you do not make these activities a matter of record, you will not have a very uniform program and it will not be too effective. We found the computer we have on our property to be a great help in keeping records. In addition to having all our employee injury records on the computer, we also record all the training which each employee receives. If their supervisor counsels them, this goes on the record. If they attend the safety car when it is on their territory, this goes on the record. If the supervisors give them any audio-visual presentations, this goes on the record. Also, any rules violations that they have go on the record, as well as, the supervisor who observed the rule violation.

I want to tell you something about this program we have on the Norfolk & Western. On the Norfolk & Western we have a standard routine in our rule violations. When an employee is observed violating a safety rule, if this is the first violation, verbal counseling is done at the time and a record is made of the violation. At the end of the month, this information is sent in to the Safety Department and it is programmed into the computer.

Now, on the second safety rule violation observed by employees, in addition to the counseling which is given, the employee is also written a letter to his home, and a copy of this goes on the record. This information also goes into the computer, outlining the incident. This is based on the second incident.

The third violation, usually results in a formal investigation, in addition to the talking, in addition to the letter. Oh, yes, we are holding formal investigations on the Norfolk & Western on safety rule violations. This is where the record keeping really pays off. It does not take long to identify the people you have who need extra help. Since we have started keeping these records we have discovered quite a bit about our employees. We have also discovered quite a bit about our supervisors.

We have found out that talking does correct many problems. We have found out, also, that when talking does not do it, the letter writing helps. Even more, we have also found out when employees really do not straighten up from the letter writing and just the talking, that formal investigation is a great help.

As I said earlier, in keeping these records, it also indicates to us what the supervisors are doing, or not doing. This helps our supervisors who really are not doing their job, and shows they can receive some counseling on this, also.

Here is how this works. Any time this employee has received an injury, this information triggers a series of actions. First, of course, we get the initial report and we dig into that to find out just exactly what happened, getting the full details. We get this, of course, from the employee's supervisor. But, in addition to this, we ask the computer for the safety history of this employee. This history includes all previous injuries, all training given the employee, all rules violations that have been observed, the handling that has been given them, and all the counseling that has been given that employee by his supervisors.

You know, it is rather hard to place the cause of injury on carelessness, when the record shows no supervisory activity in training and/or correction of the employee. It is rather hard to say that employee has a bad attitude when the record shows no injuries, no rule violations, and no counseling. As I say, we have found from these records we have had certain supervisors who needed encouragement in these activities, as a result of the records. But, do you know who the real winners are? The employees. The real winners in this whole business of keeping these records are the employees themselves.

Now I know to many of you here what I have just related sounds mighty hard-nosed — mighty cold. But, let me tell you something — something that I remember that really stands out. Several years back I went to the scene of a fatal injury. He was a gentleman up in his fifties, a hard worker, well thought of by all his fellow employees and by his supervisors. When I went there, not a person failed to talk about what a fine fellow he was. But, something else they also told me — "You know, we have been worried about him for a long time, because he just always kept on taking chances." One employee said, "I have been so afraid this was going to happen. He was always walking out in front of equipment. I was so afraid." He had been talked to.

Now this was before we began keeping these records. He had been talked to — but he was dead — a fatal injury. A good employee — and he died with a clear record.

Recently, and this has been within the past year, we had an assistant foreman who was engaged in making repairs to a pipeline. They had to have a good dry joint to make their repairs, so they put a plug up in the line. I am sure you B & B people know what I am talking about. You put the old rubber diaphragm up there and pump it full of air and it seals that joint off so you can go ahead and make your repairs. After you have finished, you just let the air out and slide it on back out. Well, it worked fine. They put the plug in there, put the pressure to it — but something did not hold, and a piece came flying out of that pipe and hit this man on his hard hat. It knocked him down and gave him a concussion. He would have been killed if he had not had on that hard hat. He would have been — no question about it.

Now, when we checked out computer printout on this particular individual, we did not find a clear record. We found two safety rule violations recorded on his record. They had been some time back and none recently. Apparently, getting the talk on the first time and the letter on the second time had reached home, because you know what he had been observed doing, and had been counseled and written on twice? Failing to wear his hard hat. Failing to wear his hard hat. "Yup."

That man does not have a clear record. He has these things on his record. But, he is alive — he is working — he is doing a great job.

Now, I ask you — which one of these two employees did we really treat the better? Now please keep in mind I am not standing up here telling you we advocate a constant battering of our employees with a lot of nit-picking activities and procedures. What we do advocate is a concern on the part of the supervisors and employees to accept their full responsibility for a safe operation and we provide the records to see that this is done.

Good Communication Needed

One last point that I want to bring to your attention that is most important in seeing that the job is done right is this matter of communication. All these things we talk about concerning the safety of the employees are not going to work if you are not communicating with your people — just like the story I told you about the eye protection. You have to communicate — and communicating is more than just talking. It is sending ideas and receiving ideas on the same wave length.

It is quite a discovery when you finally realize that people do not always hear what you thought you said. People hear you according to what their values are. Not yours. Let me give you a good example on this.

When you hear the word "strike," what does it mean to you? "Strike." I would say probably as a group of management people here today, the first thing that enters your mind probably is labor problems. But you mention the word "strike" to a fisherman and it means something entirely different. It means something pretty good. Something pleasant. You mention the word "strike" to a baseball player — depending upon whether he is the pitcher or whether he is up at bat — it can be either good or bad. The word "strike." If you are bowling, is something else. It is something good. If you are drilling for oil, looking for gold, "strike" can mean something entirely different. All the same word — but it sounds differently to different people.

This same thing is true when you communicate with your people. When you talk about wearing goggles, do you really get through to them that it is their eyes they are going to save? Even if the things do steam up, or, get sweaty, or, slide down, or, fog up, and all the other things that happen to them? I will agree with anybody — they can be mighty uncomfortable upon occasions. But, they save eyes!

Do your people really understand when you talk about lifting with their legs instead of bending over and straining with their backs? That it is their backs you are really talking about, not just the safety records?

This is the important thing that all your people must understand. We cannot deny that it is much cheaper for your railroad for you and your company, not to have people get hurt. But, the real winner in all these activities, the real winner, is that employee who does not get hurt.

Communications. Yes, you must get this across. Communications. It also requires that you listen. You listen to what Mr. Cena said earlier — many good ideas are out on the shop floor — many good ideas out there on the gang — if you will just take time to really communicate and listen when these suggestions come up and do not just brush them off.

I can well imagine many supervisors, when that employee said, "Hey, I have a great, big vat of soap suds here with bubbles in it" said — "You're fired!" But, he went to the right person and they had a great product on their hands. I appreciate that, Mr. Cena. I always wonder why that Ivory Soap floated. That was good.

This is what we are talking about— communications. When your people give you a good idea — give them some credit for it.

The Supervisor's Goal

Now, this is your true goal as a supervisor — helping employees to be able to do their job right — all the time — free from injury. We benefit — and they benefit. It is a mighty dark world when you do not have your sight to see a sunrise or a sunset and all the other beautiful things we have in this world. It is a very confining world when you are restricted to a wheel chair or a hospital bed. It is a lonely world when you do not have a hand to clasp another in friendship, or, an arm to place around a loved one. You can help your employees to continue to produce good work for you and to enjoy their off-duty hours to the fullest — if you see that your fellow employees and your subordinates, also really get involved in this safety business, in seeing that your employees learn, understand and believe these things. It calls for real communications on your part and a real understanding of your employees.

Well, that just about wraps up what I had to say to you here this morning. You noticed that I have not said a word about prompt handling of injuries. This is very important, though. You do not want to overlook that prompt handling of injuries.

I have not talked about following up to see about getting people back on the job without losing time. Again, this is important.

I have not talked about safety records. Safety records — yes, they are important.

I have not talked about claim agents and lawyers.

But, you know, I have talked about training your people to do their jobs right. If you do this, you will not have to worry about these other things. You avoid all that other business. This is your responsibility. You do this by setting the example. You do this by being a boss and not a messenger boy. By observing the work — by instructing — by communicating — by correcting mistakes — by keeping records. That is a big order, but knowing maintenance-of-way people, I know it is an order you can fill.

Right now, I think I have reached that part of my talk that reminds me, and is best described by the story of an old janitor, who was sweeping out the drug store late one night. He was sweeping away — and the telephone started ringing. He ignored the telephone. It kept on ringing. Finally, when the thing would not quit ringing, he went over, picked it up to say "Hello." The voice on the other end said, "I am so glad you are in. Do you have potassium permanganate in an aqueous solution?" After a long pause, the janitor finally said, "what did you say?" The voice said, "I said, do you have potassium permanganate in an aqueous solution?" The old gentleman said, "Look — when I told you hello, I told you all I know." Thank you very much. (Applause)

Mr. Price: Mr. Gearhart, thank you very, very much for a very good address. I think N & W should be proud of their effort and we are very glad you were with us this morning.

Mr. Gearhart: Thank you.

Mr. Price: Thank you very much.

Our next speaker should be familiar to many of you. He has addressed us on several occasions. Mr. Dempsey was graduated from the University of Notre Dame summa cum laude in 1952. He received his Law Degree from Yale in 1955. While he was at Yale, he was an officer of the Yale Law Journal.

In 1955 and 1956, he served as a Law Clerk to Judge Fay of the U.S. Court of Appeals in the District of Columbia.

From 1956 to 1959, Mr. Dempsey was a 1st Lieutenant in the United States Army, associated with the Judge Advocate General's office.

From 1959 to '60 he was Chief Law Clerk to the Chief Justice of the United States Supreme Court, Earl Warren.

He then joined the law firm of Shay & Gardner.

From 1972 to '77, he was Chairman of the National Railway Labor Conference.

On April 1, 1977, Mr. William Dempsey was elected President and Chief Executive Officer of the Association of American Railroads, Washington, D.C.

Mr. Dempsey will speak to us this morning on "Deregulation," a most timely subject for our industry. Mr. Dempsey. (Applause)

Deregulation

By WILLIAM H. DEMPSEY

President & Chief Executive Officer, AAR, Washington, D.C.

Thank you very much.

Staggers Rail Act Significant

I was asked to talk about deregulation and I will do that. I have been talking about deregulation now for about five years and it appears as if I will be talking about it for another five years. That is all right. The Staggers Rail Act that was passed last year is, I think, clearly the most significant piece of rail economic deregulation regulation that has been passed since the enactment of the Interstate Commerce Act in the last part of the last Century, the Act that did us all the dirt over all these many decades. It will take a while for us to understand the full implications of the Staggers Act and it will take us a while to get accustomed to it.

Let us together consider what it is that the Congress has wrought here. I come from Washington and I think it might be useful to think about the background of the Staggers Act before talking for a moment about what is going on under the Act. The Board of the AAR and major elements of the industry decided fairly early, about three years ago or so, to support deregulation. That was in sharp contrast to the Motor Carrier Industry, which fought deregulation hammer and tongs, and the Airlines Industry, which was so bitterly divided on the subject they could not take a position one way or the other as an industry.

Why was that? Many reasons, I suppose, but one, I think, is because it was an act born almost out of desperation. Here we have seen this great industry in a period of steady and, sometimes, precipitous decline for decades. We had not until this last year, as an industry, had some companies which were doing reasonably well. As an industry we had not had a rate of return as high as 4% of our investment since the mid-1950's, or 3%, and, since the mid-1960's we were hovering around the 2% level. We had seen the greatest business catastrophe in the history of the United States with the collapse — the spectacular collapse of the Penn-Central — and then the ensuing bankruptcies of other of the northeastern and eastern railroads, and then, finally, the collapse and truncation of the Milwaukee Road and the literal demise of the Rock Island. A number of reasons, of course, could be found for this combination of adverse developments, but one clearly enough, that most observers of the industry recognized was the fact that we were obliged to operate under a series

William H. Dempsey

of strict, stringent, burdensome regulations, whereas, on the other hand, we were in competition with motor carriers, bulk commodities, our principal competitors, most of whom had always been unregulated, and the barge industry. Eighty-five percent, and for us the important 85%, has always been unregulated.

So, this was an evil that had been visited upon us by the same Congress that we went to then for relief. The Congress, sometimes, is thought of as not the most able and most perceptive collection of individuals in the world.

Many Interests at Stake

The performance of the Congress in this terribly difficult and taxing venture into the field of deregulation of the rail industry is difficult. The interests that were at stake were large and they were conflicting. Large shippers arrayed against the rail industry, in many cases and for the rail industry in other cases. Small shippers being concerned about the change in the system to which they had grown accustomed, some railroads taking a different posture in the process, particularly, small railroads and some big carriers; agricultural interests being terribly apprehensive about it; and, arching over all, the enormous complexity of the subject for an industry that had been regulated in so many different ways for a long period of time. Consider for a moment the kinds of regulation. I am talking now about economic regulation, imposed such as the central Interstate Commerce Act.

Other types of regulation about which we are deeply concerned, some of which we share in common with the rest of the marketing industry—the kind of air pollution, water pollution and hazardous material regulation, for example, where we think, along with the Reagan Administration, that some considerable improvements can be made.

Safety regulation, with which you are all intimately familiar, was imposed under other forms of legislation and administered more particularly by the Federal Air Administration. There, again, I may say, by way of footnote, that we have seen some improvements under the Carter Administration. We expect to see — we hope to see and we have reason to believe we will see, continued improvement under the Reagan Administration on such matters as power brake regulations.

Regulations Under Two Broad Heads

What I am talking about this morning is economic regulation and it fell under the Act and under the Commission under two broad heads. First of all, rate regulation. That regulation was pervasive and it took very many forms, but what it meant, essentially, was that we could not move at all without the approval in one form or another of the Interstate Commerce Act. This really cast a baleful and widespread influence on marketing in the industry. You would have an able young, energetic, imaginative marketing man come in to say, "Listen, I think I can put together a package here that will attract the business of this major shipper who is now moving his commodities by truck," and that was sent in to the lawyers, and the lawyers would throw up their hands in dismay and say, "Oh, no, no, no — come back with something much more conservative than that. They will have us tied up in court for years." The lawyers were right, but that is the kind of dampening of initiative that is characteristic of an over-regulated industry, the kind of thing we felt we just had to get rid of one way or another. So, rate regulations.

Then, the kinds of regulations that have to do with how we spend our capital, the abandonment, for example, of unprofitable branch lines, something that goes as a matter of course in any other industry, but that is a real tooth-pulling business in the rail industry.

The kinds of jurisdiction that the Commission has exercised in relatively recent times over the disposition of our car fleet has been a problem. For a while the Commission was coming down with one hair-brained order after another having to do with the way in which the car fleet was being distributed and our executives were deeply troubled about it, deeply concerned. Again, this is the kind of poor allocation of capital, the kind of placing it into the most unproductive uses that United States Steel, General Motors or I.T.&T. have never had to face and would not know how in the world to cope with it if they did have to face it. We have had a very difficult time, as well, making any sense out of it at all.

Staggers Act Came Out Of All The Problems

Well, then, what came out of this whole business? The Staggers Act is fundamentally — it has many, many features to it that I will not be able to get into today — but it is a rate-relaxation bill at its core. It is not a deregulation bill. The industry is still subject to economic regulation in many, many respects and I fully anticipate that after some reasonable period of time of experimentation with this new law, that we all may have to go marching back to the Congress and say, "Well, that was a good first step, but now let us get on with the business of further deregulation until we really put in a position of equality with the rest of American industry. But, it is a good step and a major step forward in the rate hearing.

Now, in the allocation of capital area, hardly anything in the Act goes to the question of distribution of the fleet, for example, or abandonments, but, on the other hand, the Commission changed its posture in the course of all of this. In these areas, it did delegate to the AAR authorities that we had not previously had. It has gradually broadened its principles with respect to the abandonment of branch lines into some kind of relationship of reality, into the kind of business decisions that ought to be made. We did not see the need as time went on and the Commission changed its posture. We did not see the crying need for legislative relief in that area as we did in others.

What Does It Mean With Respect to Rates?

Well, what does it do with respect to rates? Several things — and I will speak now in broad terms.

First of all, it authorizes contract rates. I will speak about those again in a minute. But, the industry had never been able to enter into contract rates until the Commission, perhaps anticipating what Congress would do, said, "Wait a minute. We think we have been wrong all these decades. We really think you should have the opportunity, as other carriers do, other modes do, to enter into contracts with your shippers, that are tailored to their particular needs and that will give both you and them a sense of security and reliability."

But then we did not know what that meant with respect to the common carrier obligation. Could we enter into that type of contract and then have the Commission come along and tear it apart on the grounds it somehow intruded upon our obligation to serve as common carriers? That was the cloud that hung over the whole field until the Staggers Act eliminated that cloud.

Restrictions in the Act are designed to protect particularly small shippers and agricultural shippers against the danger of having no service available to them because of the proliferation of contract. We expect those restrictions will be applied reasonably by the Commission and that the end result will be that the industry will be able on a reasonable basis to enter into both short and long-term contracts with individual shippers. When you do — when a railroad does — then that contract is outside the jurisdiction of the Interstate Commerce Commission, as it well should be, because, after all, the parties have indicated by their agreement that they think it is a reasonable deal.

Secondly, all rates below a certain level are freed from Commission regulation — period. That is the end of that.

That level gradually creeps up over a period of time, and, it is not an unduly low level. I am not saying it is high enough but it is not an unreasonable, it is not a ridiculously low level, and it will mean something considerable to the industry.

Then, finally, no matter where the rate stands, no matter how high it is, if a railroad is not a monopolist with respect to that particular traffic, if it does not, in terms of the statute, have market dominance, the Commission has no jurisdiction to regulate, either. Of course, that makes a great deal of sense because under those circumstances the railroad cannot control in a monopoly way the rate at which these goods are going to be moved and, under those circumstances has no reason for regulation. Let the market place regulate it, as it does with respect to most other aspects of American business.

Finally, the Commission has the authority under the Statute, under certain circumstances that I will not go into now, but under circumstances it will give them rather wide ranging authority. They have the authority to exempt altogether certain kinds of traffic from Commission regulations. They have exercised that authority already with respect to piggyback traffic, as I expect you know, and they have now under consideration the exemption of export coal traffic. It certainly makes a great deal of sense, given the fact that export coal is about as competitive a business in which you can be involved.

It is hard to anticipate right now how far the Commission might take that authority, but it is there for them to exercise and I expect to see more in the way of exemptions come about in a reasonably short period of time.

Staggers Act Not Perfect

Now this all sounds good, but I do not want to give the impression that everything in this bill is good for the industry or from our perspective. It certainly is not. I would list for your consideration, for example, the major curtailment that will come about in the course of several years on rate bureau activities. What Congress said in effect was, "Well, all right, if we are going to give you something that is decently comparable to the way that other industries set their prices, then you are not going to be able to keep the kind of immunity from anti-trust liability that you have always had in the past." This gives us a great deal of concern, for reasons which I think I will not detain you with today. It means changes will have to be made in the way in which this industry has operated over many, many years and we are confident that it will take some time for the railroads and the shippers to adjust to these changes in rate-making practices. We are obliged to do it under the Act and I am confident that the industry contains within it the kind of intelligence, prudence and good judgment that will be necessary in making this transition.

What Has Gone On Since Act Passed?

Now, what has gone on since the Act was passed? Some people thought as we were going through all this we were somewhat like the dogs you see chasing an automobile, everyone that goes by, that, like the dog, if we ever caught deregulation, we would not know what to do with it. I think the experience of the industry in the relatively brief period of time since the Staggers Act has been effective belies that kind of negative attitude. I think the railroads have been indicating pretty much on a day-to-day basis that they are learning, that they do know how to proceed, and that all of this will be ultimately for the great benefit of the rail industry.

I will just give you a couple of examples.

First of all, we are now able, under the procedure the Commission has set up, to recover our cost increases on a timely basis. In the past this has been one of our most pressing problems, particularly in a period of surging inflation such as we have been experiencing in the last year. We are not talking about 3%, but 5%, 6%, 7%, 8%, and on up into multiple digit inflation such as we have seen in this decade. We had periods of time in which we were losing as an industry upwards of one million dollars a year because of regulatory lag. I do not mean the lag that is caused by a foot-dragging Commission. I mean the lag that is associated simply with waiting until you can get the data together that will demonstrate with some kind of precision what your cost increase has been, filing all the papers, giving everyone else an opportunity to come in with their pleadings, hearing the arguments before the Commission and then a period of time for the Commission to deliberate and to act.

That was just an enormously time-consuming process. As a matter of fact, in one of the rate proceedings we had, oh, perhaps three years ago — a general rate increase proceedings because that is how we typically recover these cost increases pretty much across the board — we, AAR, filed for the industry papers with the Commission, which, if filed one on top of the other, and, I mean this quite literally, would have reached almost to the top of the Washington Monument.

Now that is a pretty sad commentary on the efficiency and the reasonableness of the kind of regulatory environment on which this industry had to work.

Now the Commission has come in with a vastly simplified process. They have established a cost index that we maintain and update in the AAR — and they, of course, verify — and they have authorized the industry to come in for cost-related rate increases that will not just recover the cost you have already incurred and which you can prove, but will also look ahead and predict cost increases. Of course, as time goes on corrections can be made to the extent that those estimates proved not to have been well founded, either upwards or downwards. A very sensible process, indeed — one that I think the Commission could have adopted even without this legislation, but one that was certainly stimulated and encouraged by the enactment of the Staggers Act and all the abuses of the regulatory process. I do not mean intentional abuses, but almost inevitable abuses that follow when you have such a tightly organized scheme. That is of enormous benefit to the industry — enormous.

Rate Making

Well, we had a kind of test of rate-making freedom prior to the Staggers Act under the so-called Quad-R Act or 4-R act of 1976. We thought we had gotten a good measure of relief in 1976, but, in our view, anyway, the Commission just gutted that legislation and we really did not get very much out of it. One thing we did get was kind of an experiment in the free market place. Mr. Cena can tell you more about this than I can because Santa Fe has been right in the middle of it. It had to do with the deregulation of fresh fruits and vegetables from the West Coast.

We as an industry once had most of that traffic, but, as I am sure you know, the trucks began eating it up, eating it up, and eating it up, until finally it was an insignificant part and we played an insignificant role, down to something like 11% of the market place.

The Commission then, in 1979, deregulated altogether and this enabled the railroads to price in terms of actual demand and supply in the market place like everybody else does — like the trucks do — so that they could reduce rates when the demand was low and could increase rates when the contrary was true. They could match the truck rates, and they often did it on a daily basis. They could try rebates. The Southern Pacific and the Union Pacific, I think, did that last year, on apples and pears — rebates of $300. They sounded like Chrysler, or Ford, or General Motors, or any other business that is really trying to take advantage of the free market and of the American free enterprise system. It was, as you would expect, during that period of time, and, it was a short one, in which the rebates were in effect, the traffic tripled and 31 shippers who had not used the railroads before began using the railroads.

It is that kind of advertising and foot-in-the-door free enterprise, in effect, that was finally permitted.

During the first year of deregulation we had a sharp increase in our market share, from 11% to about 15%. This was the first increase in our market share of those commodities in a quarter of a century. I understand those gains are continuing. The Santa Fe, for one railroad, expects to move a large number of trailers of these commodities more this year than they did last year. The trend is ever upward in that area.

Now, that is the kind of marketing innovation that is encouraged and permitted under the Act. The Act does give you the opportunity, and it is the intention of the Congress and of the Commission, that the railroads do exercise this ability to price on an individual basis.

The shippers feared that, given rate freedom, an upward explosion of prices, would result and had no way to prove it could not happen. But, the Canadian experience was looked into — they have been deregulated now for about a dozen years — and, the fact of the matter is that rail rates in Canada — well, they have increased, of course, because costs have increased — but they have increased at a pace that is less than the pace of increase in general inflation. That may or may not be true in the rail industry as time goes on but it is certainly true that the upward explosion of rail rates which was feared has not happened. Indeed, while some upward individual adjustments had to be made —and, of course, while we have kept up better with inflation by using the cost index mechanism that has just been put into place — I would suppose, numerically, many more rate decreases have been made on an individual basis than rate increases.

In the grain area, for example, and again, Mr. Cena is more familiar with this than I am, and I expect some of you are, too, but, in the grain area we have looked into a situation in which the farmers have been storing their grain in the hope and expectation that prices will go up. So, we have just thousands and thousands of grain cars stored all over the country. You have seen the railroads try to alleviate the cost that this imposes upon them by offering a variety of incentives in terms of rates to the shippers in this period of what amounts to, in terms of our capacity, slack demand. That is just the kind of thing that we could not do before, at least, with any speed or efficiency, but that everybody else in the American economy is able to do. The Soo Line was able to reduce, in percentage terms, a great deal of its excess capacity by, as I recall, offering two free cars for every eight or ten (I have forgotten which), grain cars. I think they have taken about a thousand cars out of storage.

Speed and Reliability Of Service Stressed

The other kinds of arrangements that have come into play have to do with tailoring, with offering reliability of service in exchange for premium rates. Northern Pacific has contracts — and I am in the contract area — contracts, with shippers under which they guarantee 4-day delivery, for example, from certain points to certain other points. This has put them in a situation in which they have been able to increase reliability to a very marked degree.

Now, if you talk to shippers very often, you will hear them say time and again that, well, of course, speed is very desirable, but much more important than speed is reliability of service, because they are unable to plan their inventories and plan their production schedules. The railroads can now say, "All right, we will guarantee that, we will tailor this movement to your particular needs, but then you are going to have to expect to pay a premium for this premium service." Perhaps on the other side the shipper may say, "Well, very well and good, we are prepared to do that, but then you have to be prepared to take your lumps if you do not perform." We have contracts with that type of negative penalty provisions, as well. All of that, it seems to me, is all for the good.

The contract rate provision has been spoken of as perhaps the most important provision in the bill and, maybe it is, and maybe it is not. Only time will prove that, but it certainly is true we have not had an avalanche of contracts, as some of the small shippers and some of the farmers thought we might have, but we have had increasing exploration of this area and an increasing number of contracts. One would expect that coal would be a commodity that is particularly suited to contracts and, indeed, a number of coal contracts have been made. The last time I looked, only one major long-term coal contract had been made and that was a contract by the Illinois Central-Gulf — a twenty-year contract by Hoosier Energy.

Now that was an interesting type situation because here was a case in which the line that was to be utilized needed a significant amount of work put in and the shipper agreed to help finance that in exchange for the guarantee of twenty years, and, also, of course, on the other side a volume guarantee was made.

Here you have a situation where a shipper has to justify putting in major capital investments and, therefore, wants the kind of security that a contract will give it with respect to rates and dedication of equipment. On the other hand, the rail must put in a substantial amount of money in terms of equipment and perhaps track. A contract, at least, in principle, is ideally tailored to that sort of thing.

We have, as you know, had a relative explosion in export coal, a very unusual development for industry, particularly unusual because it has involved now, for the first time in any significant way, steam coal. Those in the industry and those outside it are looking for the ever-increasing export of coal. It would be of great advantage both to the rails, to the seaboard communities that have the ports, and, of course, the coal industry and the entire country in terms of an improvement in our balance of payments situation. Some of the railroads who are heavily engaged in the export coal business have already entered into contracts, typically two to five-year contracts, as I recall, relating to export coal. The Norfolk & Western is one of those. It has, I think, about eighteen million tons of coal a year under this type contract.

Back-Haul Contracts Being Made

It is not just with coal that we have already entered into contracts. The elimination of empty back-haul, as you know, of course is one of our major problems. We simply have to get better car utilization of this enormous capital investment we have out there in the fleet. So, railroads have made individual rate reductions in order to attract back-haul traffic. And that is the kind of thing we were not able to do, at least without great difficulty. In the past we would be faced with charges of discrimination and prejudice and everything else and unduly low rates. Now the rails are able to do that on an individual basis.

They can also do it simply by offering the rate as an incentive to fill up the cars. They have also been trying to do it, and, successfully, in some instances, on a joint basis under contract. For example, the Chessie and the Illinois Central Gulf are involved in a contract that utilizes unit trains and is designed to eliminate empty back-haul. Under this kind of contract the ICG moves a unit train of phosphate from the Gulf of Mexico to the Chessie and the Chessie delivers it to Midwestern fertilizer plants. Then, in turn, the Chessie reloads the train with grain and delivers the unit train to the ICG, which then takes it back to the Gulf for export. Now that is just an ideal type of arrangement in terms of meeting the needs of shippers, in terms of utilizing unit trains, our most efficient form of transportation, and eliminating the empty back-haul.

General Observations

I could go on and on really in terms of examples of what has been happening under deregulation, but it would be much the same sort of thing about which I have been talking. Let me close with just a few observations, general observations, about what deregulation does mean.

This, obviously, is just the beginning of our experience. The railroads have not known a deregulated environment within the lifetime of anyone employed in the industry nor their fathers nor grandfathers. It is going to take a while for all of us to learn how to cope with this new environment. The Canadians told us it took them some three to four years. I would hope with their experience we will do a little better, but it will take some time.

I think the thing that makes it just not a matter, though, of learning individually, is that we are going to have to have more integration among the components of the industry. If one is about to design a contract with a major shipper, involving a heavy commitment of rail resources, and, a promise of a particular kind of service, the marketing people are going to have to have the assurance of the operating people that indeed it can be done. It has to be done with the commitment the service can be made without untoward consequences in respect to the obligations the railroad has to its other customers.

The lawyers will play quite a different role now, at least, in some measure. I am a lawyer and I do not like to be critical of lawyers and I do not mean to be — but the lawyers should not be, in my judgment, running the business, under the Interstate Commerce Act. It was not that they wanted to, but they almost had to, because, who else could deal with the Interstate Commerce Commission?

Anyway, the lawyers are going to have to play a different role. For example, we are concerned, for as we gradually lose the anti-trust immunity that we had, everyone is going to have to think in a different mode. We are going to have to be very concerned about any charges that we might be running afoul of the anti-trust laws. Lawyers are going to have to be playing the same role in the rail industry that they have for so many years in other industries.

I think that can all be managed. I know from my experience with the lawyers, for example, in the industry now, with the marketing people and the operating people, that they are going at it with a will. I am just terribly heartened to see that. I think this has been a good start and I think this industry, given the kind of talent that it has, is well positioned to capitalize on this start.

I may observe, I said at the start we had not had a rate of return in the industry of as much as 4% since the mid-1950's, but we did last year, about 4½%. It is nothing to brag about, it is nothing to sit on and say, "Well, "O.K.," that is fine, we have done it." The Interstate Commerce Commission has said we must have 11% as an industry and that is where we need to go, but I want to say that is the best year we have had in 25 years. That means, to me, that the line of this industry is not going down, but it has started going up, and that is due to many things. It is by no means due entirely to deregulation. It is due to the resurgence of coal. We have what appears to be a greater utilization of our car fleet. We have the environmental considerations. We are the most environmentally benign mode of carriage in the country.

Then, we have, finally, the benefits you people will recognize, the benefits of the massive expenditures that the rail industry has made in the past three or four years on plant and equipment. That stands greatly to this industry's credit because that was done when the industry as an industry was suffering historically poor rates of return. It took a great deal of courage and a great deal of confidence in the future of this industry. The rewards are now beginning to be realized and I am confident that this is but the start, I hope when I see you next time, whenever that is, I will be able to say, "By George, I was right. The rate of return is now up to 6%, and it is still climbing."

Thanks so much for having me. (Applause)

Mr. Price: Thank you very much, Mr. Dempsey. It is good to hear optimism in our industry again.

I am now going to turn the rostrum back to the President, Ben Sorrels.

President Sorrels: I note that as of ten A.M. this morning, the registration was as follows:

59 B & B
124 Associates
157 Roadmasters

72 ladies and 78 guests, for a total of 490, and, of course, registration is continuing.

President Chambers, do you have any announcements at this time?

At 1:15 the Roadmasters will meet in this room. The B & B will meet in Regency B at 1:00 P.M. It is 1:15 for the Roadmasters and 1:00 P.M. for the B & B.

I declare this Joint Session adjourned.

. . . Recessed at 11:30 A.M. . . .

MONDAY AFTERNOON SESSION

September 14, 1981

President's Address

By J. W. CHAMBERS

Bridge Construction Engineer, Missouri Pacific, St. Louis, Mo.

J. W. Chambers

Gentlemen, please take your seats. Will those at the door please advise people outside that the Bridge and Building Session is beginning? Please, close the doors?

(Pause)

I hereby bring this 86th Annual Conference of the American Railway Bridge and Building Association to order. I extend a warm welcome to those in attendance. It is good to see the many familiar faces again and especially guests, visitors and members who may be here for the first time.

A sincere invitation is extended to all of the ladies to attend any of our sessions which may be of interest to them.

It is my pleasure to introduce the officers and directors of the Association. Please hold your applause until all have been introduced.

Junior Directors:

Mr. O. D. Anthony, Asst. Chief Engineer, Bridge & Structure, B.&A.R.R. Mr. Anthony serves on our Membership Committee and as a Joint Association Representative and on the Necrology Committee.

Mr. J. T. Kapp, Project Engineer, ConRail. Mr. Kapp serves on the registration desk and the Special Features Committee.

Mr. D. J. Lewis, Designer, I.C.G. Mr. Lewis serves on the Ladies Entertainment Committee, Joint Associations and Resolutions Committees.

Second Term Directors:

Mr. D. A. Bessey, Asst. Chief Engineer Structures, C.M.St.P.&P. Mr. Bessey is Chairman of the Ladies Entertainment Committee and serves at the registration desk.

Mr. J. N. Michel, Manager Engineer Design, Amtrak. Mr. Michel is Chairman of the Advertising Committee and serves on Publications Committee.

Mr. P. H. Saletnik, Asst. Engineer Buildings, C.&N.W. Mr. Saletnik serves on the Conference Program Committee and the Hotel Arrangements Committee.

Senior Directors:

Mr. J. W. Davidson, Asst. Director Bridge Engineer, BN. Mr. Davidson is Chairman of Standing Committee No. 3 "Training for B.&B. Foremen."

Mr. C. M. Russell, General B.&B. Supervisor, Southern. Mr. Russell is Chairman of the Resolutions Committee and serves on the Special Subjects and Advertising Committees.

Mr. J. M. Williams, B.&B. Supervisor, E.J.&E. Mr. Williams is Chairman of the Registration Desk and serves on the Nominating and Membership Committees.

Mr. D. C. Gould, Asst. Structure Engineer, U.P. Immediate Past President, Chairman of the Nominating Committee.

W. E. Sturm, Senior Project Engineer, E.J.&E. Past President Mr. Sturm is Chairman of the Hotel Arrangements Committee, Publications Committee and Joint Association Representative. He also serves on the Nominating Committee.

Next we have our Vice Presidents:

Mr. O. C. Denz, Supervisor Building Maintenance, C.M.St.P.&P. He is Chairman of the Special Subjects Committee and is Junior Vice President.

Mr. W. R. Hyma, Bridge Engineer Systems, A.T.&S.F. He is Junior Vice President and Chairman of the Special Features Committee.

Mr. R. C. McMaster, Manager Facilities and Structures, B.&L.E. He is our Senior Vice President and Chairman of the Conference Program.

Mrs. Pat Weissmann, Secretary of the Association. Mrs. Weissmann is new and we are looking forward to her help and management of the Association's Office.

Mr. W. F. Armstrong, Engineer Buildings, C&N.W., Treasurer.

Mrs. Ann Wilson, former Secretary of the Association. Mrs. Wilson resigned when her husband retired and has generously been helping Pat to break in and to get used to the details.

A person like Mrs. Wilson is extremely valuable to an association like ours. Presidents, Vice Presidents and Directors come and go but the Secretary stays on and is the glue that keeps it all together year after year.

Although we are sorry to see her leave, we wish her and her husband well in retirement. Ann, we thank you for your devotion to the Association, for a job well done and wish to say that you were a large asset to our Association, which is about the best that can be said of anyone.

— Applause —

Thank you all. Please be seated.

At this time the schedule says "President's Address" and as required by the by-laws of our Association I am obligated to report to you on the general condition of the Association.

Total membership of the Association June 1, 1981 was 690. Since June 1, 1980 the membership has risen 22. Besides the additional members since June 1, a nice modest increase, we are in good condition financially. You will receive a detailed report in the business session. A raise in dues was seriously considered, but was tabled for this year, but we will probably have to raise dues soon.

The Association is attracting more younger members, and of these, more who are willing to serve on committees and eventually rise in the ranks of the Association.

This organization has served as a clearing house for ideas since 1891. Conditions today are more challenging and much more complex than they were ninety years ago. Your Association has played its part well in staying in the forefront in distributing among you new conceptions, ideas and ways and means. These meetings provide the means whereby the exchange of information can take place through discussion of problems both formally and informally.

We have a very good mixture of people here, by age grouping. The young, the intermediate and the weather beaten, and probably in about equal proportions. We weather beaten ones are getting ready to hand things over to the intermediate or seasoned group. They are eager to take over and the young are impatiently wondering how they can get past the seasoned ones. Some do, and it is all very interesting.

The seasoned are building upon and adding to the accomplishments of their predecessors. The young and vigorous are eager to do so, are expected to do so, and will do so.

Right here in this organization is the place to start. You cannot get it all by reading about it. You have to get in it. Here you can widen your acquaintance with people; with problems and situations, and how they were solved; with concepts and ideas, and ways and means to apply them; and, finally, enjoy the experience of participating in making reports and sharing your experiences with others as they share with you.

I am sure that your continuing contributions and involvement will keep this organization meeting its stated goals in the years to come.

— Pause —

We are giving out the remainder of the portfolios this year at the registration desk. Be sure to get yours as we expect to run out.

Two door prizes will be given away again at the business session Wednesday morning.

As my term of office concludes with this conference, I wish to extend my sincere gratitude and appreciation for the work done by the executive committee. It has been a privilege to serve as your president.

The primary object of the Association is met by those who do the nitty-gritty.

Following each report you are encouraged to ask questions. Please stand —state your name and affiliation and direct your questions to the Committee Chairmen.

Our first feature this afternoon is a continuation of one of last year's features, "Float in Bridge Project on the "Milwaukee Road."

Mr. Bessey, Asst. Chief Engineer Structures on the Milwaukee Railroad and one of our directors will present this report.

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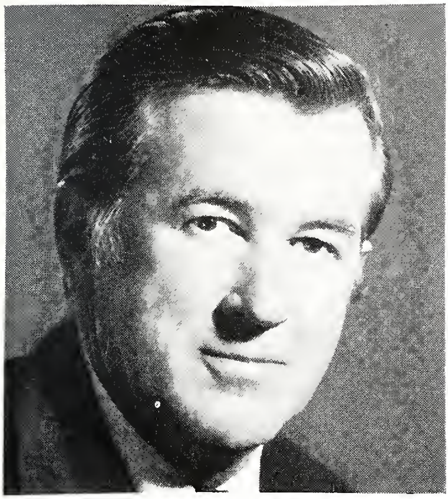
Float-In Bridge Project on Milwaukee Railroad

By D. A. BESSEY

Assistant Chief Engineer Structures
Chicago, Milwaukee, St. Paul & Pacific, Chicago



D. A. Bessey

Members of the Association and guests. Last year at the American Bridge and Building Association Conference, I made a presentation covering the reconstruction of the Milwaukee Railroad's Mississippi River Bridge, L-268, at Hastings, Minnesota. However, because of delays in construction, the project was not completed by last year's Conference, so, I closed the presentation with a "To Be Continued."

The main event or the most interesting part of this project was the float-in of the 320′ lift span. This occurred on October 4, 5 and 6, 1980, approximately two weeks after the Conference. I will, therefore, summarize what was discussed last year at the presentation and continue with the lift span float-in and the completion of the project.

Summary of 1980 Presentation

The Milwaukee Railroad bridge across the Mississippi River at Hastings, Minnesota, was built under authority of an Act passed by the Minnesota Legislature in 1864 and the original bridge was constructed in 1871. Numerous replacements were carried out in the late 1800's and, then in 1891 (approximately 90 years ago), a new bridge was constructed. This bridge is basically the same structure that was replaced last October.

The structure consisted of a 38′ deck girder span on the east approach, a 300′ swing span and the west approach consisted of two (2) 147′ truss spans and 22 deck girder spans for a total length of 1,755 feet.

Originally the maximum channel width was 130 feet and over the years, due to construction, the channel was reduced to approximately 126 feet. This channel width was adequate in 1891. However, with present-day river traffic with tows of 3-barges wide or 105 feet, the 126′ channel provided inadequate horizontal clearance.

During the past 90 years, numerous proposals were submitted to replace the structure to provide a greater channel width. However, the bridge was merely modified, strengthened, converted from steam to electric, and many other changes were made during the years that followed. Some of the proposals such as the one presented in 1916 was to provide a 350′ swing span, another proposal was a 400′ swing span which would provide a 180′ channel. The cost for this proposal was $150,000. First mention of a lift span was in 1929. It was proposed to construct a 215′ lift span at the cost of $135,000. None of these proposals were carried out. In 1944 during World War II, some preliminary discussion was made to alter the structure for proposed navigation improvements under the cost-sharing policies of the Truman-Hobbs Act.

The Truman-Hobbs Act allows the federal government to order the alteration of a bridge which obstructs navigation and provides guidelines for the sharing of the cost of such alterations between the federal government and the bridge owner, in this case, the Milwaukee Railroad. Nothing more was progressed at this time. Then on November 30, 1948 a "Notice to Alter" was received from the Department of the Army. A "Notice to Alter" was issued, however, due to delay in financing and numerous other postponements, no other action was taken until approximately 21 years later.

In 1970, the Coast Guard held an informal meeting in Minneapolis to gather information and to reexamine priorities for alteration of the Milwaukee Railroad's bridge at Hastings. Another six years passed with various notices being issued, more delays, and then on May 26, 1976 authorization to proceed with drawings and specifications for the reconstruction of the bridge. Drawings were prepared, bids were issued and the contract was awarded to Hensel Phelps of Greeley, Colorado. The actual construction began in January 1979.

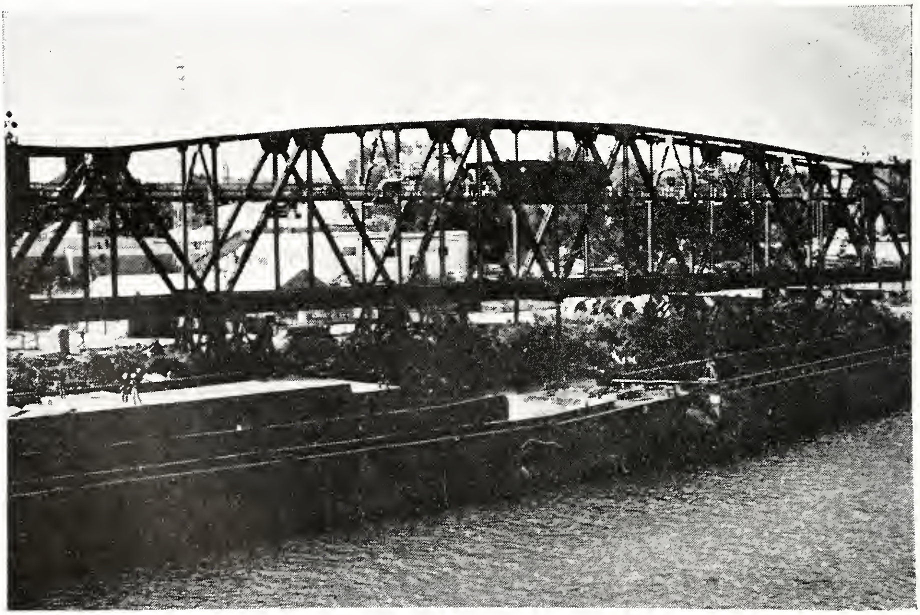
I would now like to show you a slide presentation covering a portion of what was presented at last year's Conference and show you slides of the float-in of the 320′ lift span and the completion of the project.

Slide 1—Bridge L-268 at Hastings as it appeared in 1932.

Slide 2—Bridge as it appeared in 1937.

Slide 3—Here is a view of the Hastings bridge as it appeared in 1965. The structures starting at the east end, or right side of the picture consisted of a 38′ deck girder span, one 300′ swing span, two 147′ through truss spans, and 22 deck girder spans with a total length of 1,755 feet. The portion of the structure to be replaced consists of the 38′ girder span, the 300′ swing span and the first 147′ truss span.

Slide 4—The main reason to alter the structure was for navigation improvement. Here is another reason for the



Lift span under construction. Barges for temporary pier protection.

replacement of the structure. This is the downstream center pier protection crib. This crib was hit 12 times in 1979, causing damage in excess of a quarter of a million dollars. This crib, of course, was removed when the new structure was completed.

Slide 5—This shows the extremely close clearance between the barge and the old bridge structure.

Slide 6—The top drawing shows the old bridge structure with the 38′ girder span to the right, the 300′ swing span, and the 147′ truss spans. The drawing below shows the new structure with a 55′ span and the east tower, the 320′ lift span and Span #3, a 104′ long truss span with the west tower and then the present truss span which remains in place. Total length of the new structure is 489 feet.

Slide 7—This indicates the elevation and plan of the new bridge structure indicated in yellow.

Slide 8—This indicates the sequence of construction with the various phases of construction of bridge L-268.

Slide 9—Indicates the sequence of construction with the first stage which involves the reconstruction of Pier #1 and new Pier #3 indicated in yellow.

Slides 10—This picture was taken in January 1979 when the contractor moved on to the site to start construction. He is in the process of assembling barges.

Slide 11—This is the summer of 1979 when work was in progress driving the cofferdam for the reconstruction of new Pier #1 (off to the righthand side) and the cofferdam for the construction of Pier #3 (to the lefthand of the swing span).

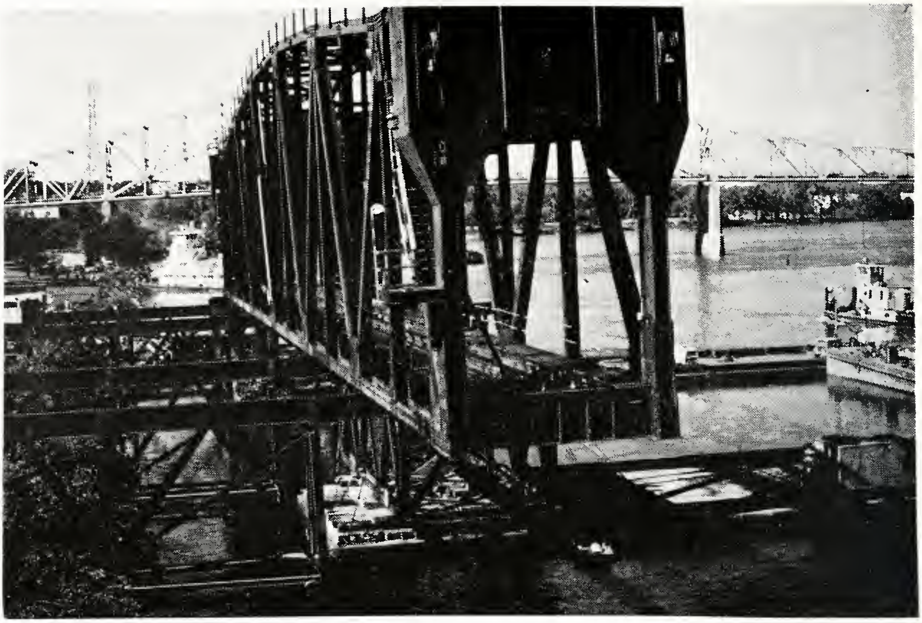
Slide 12—This is the existing Pier #1 and off to the right, almost off the picture, is the sheet piling for the cofferdam at Pier #1.

Slide 13—The excavation inside the cofferdam for construction of Pier #1.

Slide 14—Inside the cofferdam for the construction of Pier #1. Excavation was completed and the contractor started placing concrete on October 1, 1979.

Slide 15—And this is the new Pier #1 in its completed stage. This picture

Lift span on shoreline falsework.



Lift span moved off of the shoreline falsework onto the barges.

was taken on February 5, 1980.

Slide 16—This indicates the resurfacing of the east abutment.

Slide 17—The next sequence indicated in the drawing is the rebuilding of Span #1. The 55′ span on the east approach.

Slide 18—This picture was taken in October 1979 and shows the preliminary construction work involved to bobtail the old swing span.

Slide 19—Preparing to remove the existing 38′ girder span, east approach. This work was carried out on November 4 and 5, 1979, the first of three outages. There was a total outage of approximately 50 hours.

Slide 20—Removing the existing 38′ deck girder span, east approach.

Slide 21—Setting the tower base at new Span #1.

Slide 22—This is setting the new tower base at Span #1, with the old swing span in the background indicating the temporary end posts.

Slide 23—Here both tower bases now in place at Span #1.

Slide 24—This is truss span of Span #1 which was leapfrogged into place.

Slide 25—This indicates the Span #1 in place. They worked through the night to complete the installation of this span.

Slide 26—This indicates the bobtailing of the existing swing span. The old span #1 was 38′ long and the new span is 55′ long. Therefore, it was necessary to bobtail the east end of the swing span. The swing span was opened over the top of the crib and the cutting process was under way.

Slide 27—This indicates the bobtailing operation. The ends were placed on blockings and the new end posts indicated here were installed.

Slide 28—Continuation of the bobtailing operation which continued on during the night.

Slide 29—A temporary end posts were welded into place and this indicates the removal of the existing end posts.

Slide 30—The bobtailing operation was completed. Steel counterbalancing was placed at the end of the span to make up for the loss of weight.

Slide 31—Moving the swing span into

place after the bobtailing operation has been completed.

Slide 32—The first train over the new Span #1 which is an Amtrak train on Tuesday morning, November 6, 1979 after 50 hours of outage.

Slide 33—The construction of the tower at Span #1 was continued on through the winter.

Slide 34—Installation of the main sheave on top of tower #1.

Slide 35—Filling of the counterweight in Span #1 being filled with heavy weight concrete. This was taken in August of 1980.

Slide 36—This is the view of new Pier #1, on the left, and the existing Pier #1 on the right. The load, of course, has been removed off of Pier #1.

Slide 37—This is the demolition of existing Pier #1.

Slide 38—The next phase of construction, which is the assembly and placement of Span #3 and the temporary jump span. The jump span is between old Pier #3 and new Pier #3.

Slide 39—Start of the construction of the falsework on the east shore. The falsework was used to construct Span #3 and later the main lift span.

Slide 40—This is the construction of Span #3 under way on the shoreline falsework.

Slide 41—Span #3 on the construction platform, prior to being transferred on to the barges.

Slide 42—During the winter and during the process of constructing Span #3, (as you can see in the background), there was no river traffic. So the contractor proceeded to dismantle the upstream center pier protection crib. Here the crib has been removed and only the nose remains.

Slide 43—This indicates the preparation of loading Span #3 from the shoreline falsework on to the barges.

Slide 44—This is Span #3 which has been pulled off the shoreline falsework onto the barges.

Slide 45—Span #3 on the barges and being floated out into the center of the channel. The Span #3 float-in took place on the weekend of March 30 and 31, 1980. It required only about a 28-hour outage.

Slide 46—Span #3 on the barges being floated into place. This truss span

Lift span on the two 40 ft. x 200 ft. barges prior to the final float-in

is 105′ long and weighs approximately 300 tons.

Slide 47—Span #3 being floated up to the opening.

Slide 48—Here you can see Span #3 on the barges being floated up to the opening. The old Span #3 is in the background.

Slide 49—Span #3 moving into place.

Slide 50—The span was moved through the open channel and then moved back upstream.

Slide 51—This is looking west with the falsework on the barge, picking up the old span and moving new span into place.

Slide 52—This indicates the new Span #3 in place. The old span is in the background. The temporary jump span is to close the gap between old Pier #3 and new Pier #3.

Slide 53—Indicates picture of the span in place and the temporary jump span. The swing span was in the open position.

Slide 54—The next phase of the construction was to erect the towers on Span #1 and Span #3 as you see in yellow, third picture.

Slide 55—The next phase of the construction is to assemble and place the 320′ lift span.

Slide 56—This indicates the elevation and plan of the new 320′ lift span.

Slide 57—This indicates the elevation and plan of the new lift span and the new east and west approaches. Total length of the new structure 489 feet.

Slide 58—In February 1980 the erection of the 320′ lift span was started. The erection started in the middle of the span to permit the construction of the machinery house at an early date.

Slide 59—Indicates the continuation of the assembly of the lift span and this indicates the machine house floor which was first to be assembled.

Slide 60—This is an over-view of the construction site with the lift span being constructed, as you can see in the middle of the picture. When the upstream center pier protection was removed to facilitate the future float-in of the lift span, it was necessary to provide temporary pier protection and these three barges were tied together to provide protection for the center pier. This pic-

Removal of the old ring girder and wheel assembly.

Total weight of the lift span as you see it here is approximately 1,000 tons.

ture was taken about June 1980.

Slide 61—This was taken in June 1980 indicating the progress of the fabrication of the 320′ lift span.

Slide 62—The lift span was constructed on the high strength rollers mounted on the construction platform. Picture of the rollers.

Slide 63—Another picture of the rollers carrying the span.

Slide 64—This picture was taken in July 1980 indicating the progress of the fabrication of the lift span.

Slide 65—Fabrication of the lift span. August 1980 the span is nearly completed. Total weight of the lift span as you see here is approximately 1,000 tons.

Slide 66—This is a view of the construction site. The lift span on the falsework off to the right. The two towers are completed. As you can see, the temporary jump span in orange off to the left and the three barges that protect the center pier.

Slide 67—This is a picture of the new operator's house under construction.

Slide 68—This is a drawing of the completed structure. Total structure is 489 feet long, indicated in yellow and the three piers indicated in red are the piers of the old structure which were removed.

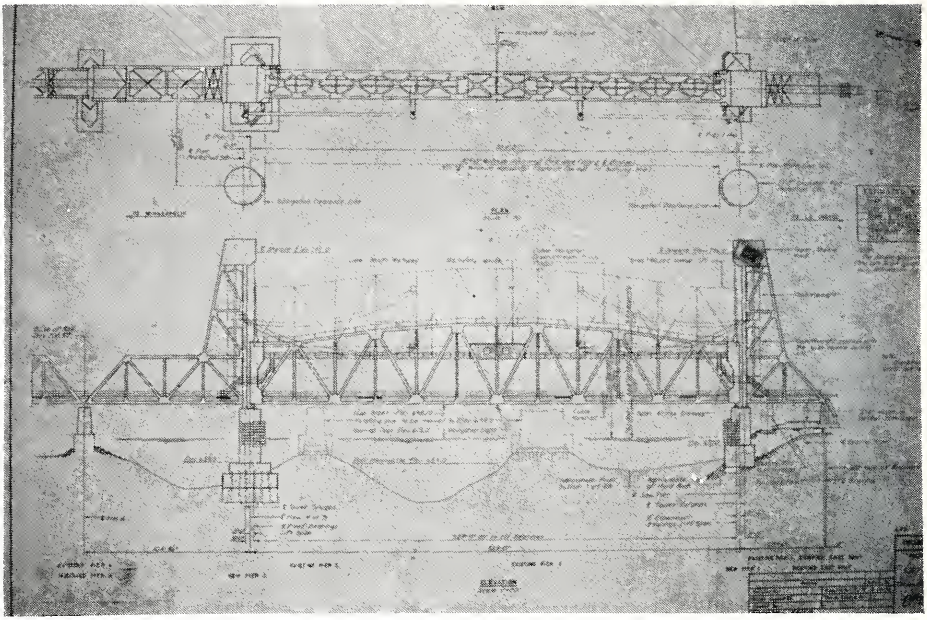
Slide 69—This picture was taken on September 29, 1980. The lift span was rolled off the falsework on to the barges and one of the problems that happens in a project of this type — there was a mishap. One of the rollers on the south end came off of the falsework and then the other three rollers fell off too. It took about three days to jack the span up and get it pulled off on to the barges.

Slide 70—This indicates the span partly on the falsework and partly on the barges and off to the right is the location of the missing roller.

Slide 71—Barges were moved in place on the south end to pick up the weight of the span to permit sliding it over on to barges.

Slide 72—This is another view indicating the location where the roller fell off. The roller failed to track, the span fell down on the falsework. You can't see it in the picture but it sheared the top flange of the falsework.

Slide 73—During the process of lift-



Drawing showing plan and elevation of the new structure.

ing the span to permit sliding it on to the barges, the channel was blocked and, after the problem was corrected, a considerable number of barges had to be moved through the channel.

Slide 74—This is another view of the lift span just as it was pulled off of the shoreline falsework on to the barges.

Slide 75—October 2 the span was moved to the center of the barges and floated across the river — prior to the removal of the old span.

Slide 76—This picture was taken the next day on October 3 indicating the lift span on the two 40′ x 200′ barges.

Slide 77—Another view of the span sitting on the west bank of the Mississippi River. This is on Friday morning, October 3.

Slide 78—This is a view of the construction site indicating the two new towers and the old swing span which is prior to its removal.

Slide 79—At 6:00 p.m., Saturday, October 4, the swing span was closed for the last time and the contractor proceeded to burn off the I-bars and remove the machinery house as the first step in the removal of the old swing span.

Slide 80—This is cutting of the I-bars. First step in the removal process.

Slide 81—Cutting the I-bars.

Slide 82—This is removing the supports under the machinery house, getting ready to lift off the structure.

Slide 83—The next morning, October 5, the barges and falsework were moved into place under the old span.

Slide 84—This is cutting the ring girder loose from the center pier. Cutting process continued on into the night.

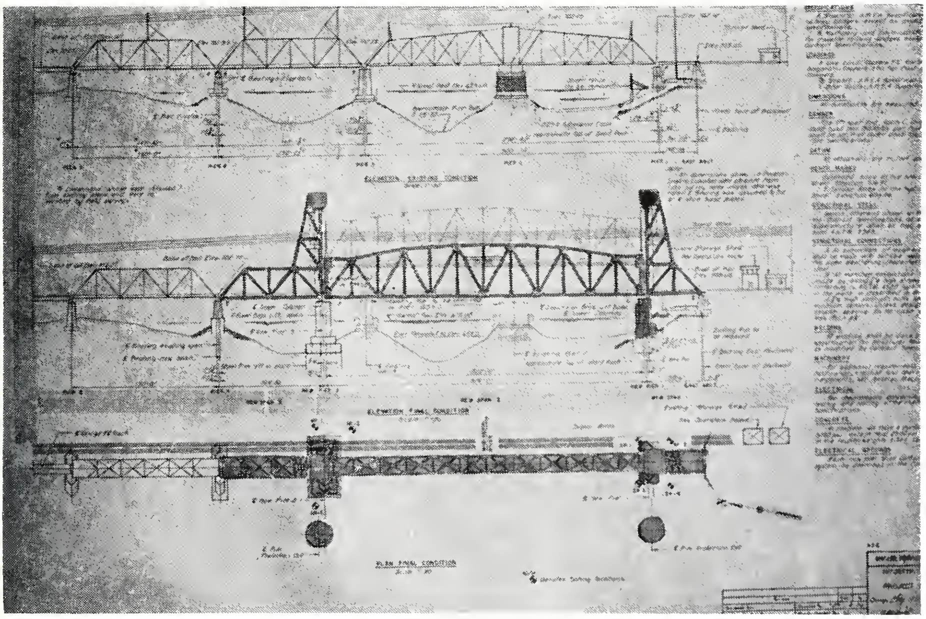
Slide 85—During the cutting process, the temporary jump span was removed.

Slide 86—I guess when you're standing around waiting for some progress in the removal of the old span, with camera in hand, this is just another picture of the new lift span setting on the barges on the west side of the Mississippi River.

Slide 87—Another view of the lift span.

Slide 88—Picture of a couple of bystanders; but these bystanders happen to be Stanley Thoroughman (Chief, Bridge Section, 2nd Coast Guard District in St. Louis) and Freeman Drew (retired Asst. Chief Engineer-Structures

View of the completed structure.



This is a drawing of the completed structure. Total structure is 489 feet long.

Milwaukee Railroad) who was in on the initial planning of the new structure.

Slide 89—While the cutting process was under way, the west track section of Span #1 had to be lifted and slid out of place to permit sliding in the new span.

Slide 90—This is the night on October 5. During the jacking process the center ring girder had to be cut loose and an attempt was being made to lift the structure.

Slide 91—Picture was taken later the night of October 5 and another attempt being made to lift the span. All together, three different attempts were made to lift the old span.

Slide 92—At 4:37 a.m. on Monday, October 6, the span was cut loose from the center pier and floated to the west shore of the river. All photographers should never be without their tripod. I left mine back at the motel at 4 almost 5 o'clock in the morning, so I attempted to take this picture without using the tripod. Interesting effects but it doesn't really show the bridge.

Slide 93—This is a view taken Monday morning, October 6, of the old swing span setting on the barges ready to be cut up for scrap.

Slide 94—When the span was removed, the ring girder was lifted off.

Slide 95—This is removing the wheel assembly.

Slide 96—This is a picture showing the channel opening with the swing span removed and the ring girder and wheel assembly removed ready for the float-in.

Slide 97—This is a little after 2 o'clock in the afternoon on Monday, October 6. The three tugs are preparing to move the swing span away from the shore and float it into place.

Slide 98—This is beginning of the float-in process. Next series of slides represent approximately 40 minutes from the time the span was moved away from the west shore and placed over the bearings.

Slide 99—Float-in

Slide 100—Float-in

Slide 101—Float-in

Slide 102—Float-in

Slide 103—Float-in

Slide 104—The lift span is being floated into the opening between the two towers.

Slide 105—Float-in

Slide 106—This is a little over 30 minutes from the time the span was moved away from the west shore.

Slide 107—Float-in

Slide 108—Float-in

Slide 109—Float-in

Slide 110—Span being moved into opening.

Slide 111—Span almost over the bearings.

Slide 112—Span has been floated in over the top of the bearings. As I said, approximately 40 minutes from the time it was pulled away from the shore.

Slide 113—Another shot of the old swing span setting on the west shore. This was taken from the top of the new span.

Slide 114—This is view taken late in the afternoon of October 6. The ballasting of the barges is underway and the span has been lowered down on the bearings.

Slide 115—While other work was underway, the panels on Span 1 and 3 were being reset and the control cables were being connected.

Slide 116—On into the night the sections of track on Span #1 and #3 were being replaced.

Slide 117—This is picture of our Trainmaster operating the switch engine. This is approximately 11:15 Monday night. The local switch engine and two box cars, crossed the bridge on the westbound move.

Slide 118—Here again, picture taken without the benefit of a tripod. This was taken from the locomotive as we were approaching the bridge.

Slide 119—Picture of Nathan Smith, our Chief Engineer, and Bill Ashton, the Project Manager for Hensel Phelps Construction Company, riding the first locomotive across the bridge.

Slide 120—At approximately 1:15 a.m. on Tuesday morning, the first freight train passed over the span.

Slide 121—Here you see the caboose.

Slide 122—This picture was taken on July 25, 1981. The citizens of Hastings sponsored a bridge dedication ceremony along with other festivities.

Slide 123—The Delta Queen on a trip down river, stopped for a few hours and took part in the bridge dedication. That's Bessey up there making a speech.

Slide 124—At the close of the formal dedication or the speeches, the Delta Queen pulled away from the levee, went up river about 1/4 mile turned around.

Slide 125—And proceeded down river accompanied by approximately 15 pleasure crafts playing the steam Calliope. As you can see the steam coming out of the Calliope at the stern of the Delta Queen, blowing their horn. This picture shows the Delta Queen passing underneath the highway bridge.

Slide 126—And now the lift span was raised, the Delta Queen and the pleasure crafts passed under the span and released thousands of balloons as a conclusion to the dedication ceremony.

Slide 127—Delta Queen passing under the span.

Slide 128—Delta Queen passing under the span.

Slide 129—Delta Queen under the span.

In conclusion, here are a few statistics.

The lift span weighs 1,996,480 lbs., or approximately 1,000 tons. The entire new structure which is 489 feet long has a total steel weight of 3,059,000 lbs., or approximately 15,030 tons. All the steel is A-588 weathering steel. In addition to the east and west tower spans and the new lift spans, two 27 foot diameter pier protection cells are on the upstream side of the bridge. The lift span travel is approximately 36 feet which provides 60 feet vertical clearance above normal pool. The lift span is designed to raise and lower in approximately 1½ minutes. It is powered by two 30 horsepower motors and equipped with an emergency gas engine.

This new structure will certainly be a vast improvement to river navigation and is certainly greatly beneficial to the Railroad as it should provide a substantial reduction in maintenance cost and because of the 320′ channel under the lift span, the bridge should be relatively free from boat damage.

President Chambers: Thank you, Mr. Bessey for a very enjoyable, interesting presentation and a nice job. I am sure that those who saw the first episode, as I did, were glad to see the happy ending.

Mr. Hyma, Bridge Engineer Systems, Santa Fe Railroad and a Vice President of the Association will introduce the next speaker. Mr. Hyma is also Chairman of the Special Features Committee.

Vice President Hyma: Our next speaker is Mr. Chester Burchett. Mr. Burchett is a graduate of the U.S. Naval Academy and has a Master of Science Degree from the U.S. Naval Post Graduate School at Monterey, California. After serving eleven years as a Navy pilot, Mr. Burchett left the service and spent several years in real estate research evaluation and development. In 1975, he joined Hydro Tech Systems, Inc., where he was responsible for the management of multimillion dollar deepwater pipeline repair projects. Since 1978, he has been affiliated with Gulf Interstate Company, first in their Marine Projects Department, then as Project Coordinator for Marine Systems, and now as Vice President and General Manager of Hydrodynamics and Technological Research which is a Gulf Interstate subsidiary headquartered in Houston, Texas. This company had its start as Hold That River, Inc. or HTR. The change in name from Hold That River to Hydrodynamics and Technological Research reflects a transition from total construction services to engineering, planning and general contractor services.

Mr. Burchett's topic today is River Bank Stabilization through Effective Erosion Control. It is my pleasure to present Mr. Chester Burchett.

River Bank Stabilization Through Effective Erosion Control

By CHESTER W. BURCHETT

Senior Vice President of Hold That River, Inc., Houston, Texas

Chester W. Burchett

Condensed Text

Hold That River's system of erosion control was developed by Kenneth W. Henson in 1950 and formed the basis of his company, Hold That River Engineering. That company was acquired by Gulf Interstate Company in 1979, and the name was abbreviated to Hold That River, Inc. As one of The Gulf Interstate Companies, Hold That River is backed by the engineering, financial and managerial resources of one of the more successful engineering firms in the United States.

Since Hold That River's inception over twenty years ago, more than 100 systems have been successfully installed in the U.S. and South America. Even the earliest systems are still holding their rivers and performing as designed.

Hold That River is a full-service company, providing complete turnkey service. Our personnel study your specific erosion problems and custom-design a configuration of flow control jetties to control the river's course and protect your installations, bridges or roadbeds. With your approval, we handle all planning, government permits, purchasing and construction. Our exclusive experience in erosion control enables HTR to work quickly and efficiently — saving time, money and facilities.

If erosion around riverbends is endangering your installation, do not resign yourself to expensive relocation work. Our unique patented system of erosion control has proved effective in more than twenty years of usage and is flexible enough to cure any river erosion situation you might encounter. Also, operations do not need to be suspended while we work. HTR controls erosion by redirecting the forces of the river away from critical areas. In many cases, we can actually rebuild and restore the river bank to a stable condition, allowing natural growth and ground cover to return to a previously unsightly landscape.

Hold That River, Inc., designs and installs this patented system for river erosion control to protect:

- pipeline crossings
- bridge abutments
- power line towers
- aerial pipeline crossing supports
- railroad trestles, bridges and rights-of-way.

Hold That River, Inc., designs and control is one of engineering simplicity with effective results. It consists of a series of permeable jetty structures designed and installed to remain on the river bed where erosive action would normally cause radical changes in channel shape. The system reduces flow velocity and turbulence along the river bed, adjacent to the river bank, where excessive erosion would otherwise occur.

The most common form of control structure consists of a large permeable panel of negative buoyancy. The panel rests directly on the river bed on the upstream side of two steel piles. Held upright by the piles — but not restricted — the panels remain on the river bottom at all times. They cannot be undercut. Rather, they adapt themselves to changes in channel shapes as these changes occur during flood stage. Individual structures may be developed in a variety of forms to fit unusual conditions.

Henson Permeable Spur Jetties attack the source of erosion problems by utilizing the natural forces of the river. They stabilize the river's course to prevent further erosion in the danger zone affecting a facility. Other methods, such as rip-rap or bulkheads, are temporary at best. They fail to eliminate basic erosive forces, therefore, are "fighting" the force of the water rather than "using" this force as is done in the HTR system concept. Historically, most systems of erosion attempt to block the river with bulkheads, rip-rap or other physical structures. This can only be a short-lived solution. The river will, sooner or later, erode behind these obstacles creating an erosion problem worse than initially encountered.

Hold That River's unique system, on the other hand, effectively moves the source of erosion away from the river bank, thereby protecting the toe of the bank from further erosion and maintaining the necessary foundation to support the high bank overburden. The most dangerous and rapid form of erosion is that called "shear bank collapse" wherein tremendous sections (sometimes tons) of river bank shear off and fall into the river because of lack of support due to erosion undercutting the bank at the bottom of the channel. A system of permeable jetties working on the bottom under the water prevents this erosive action.

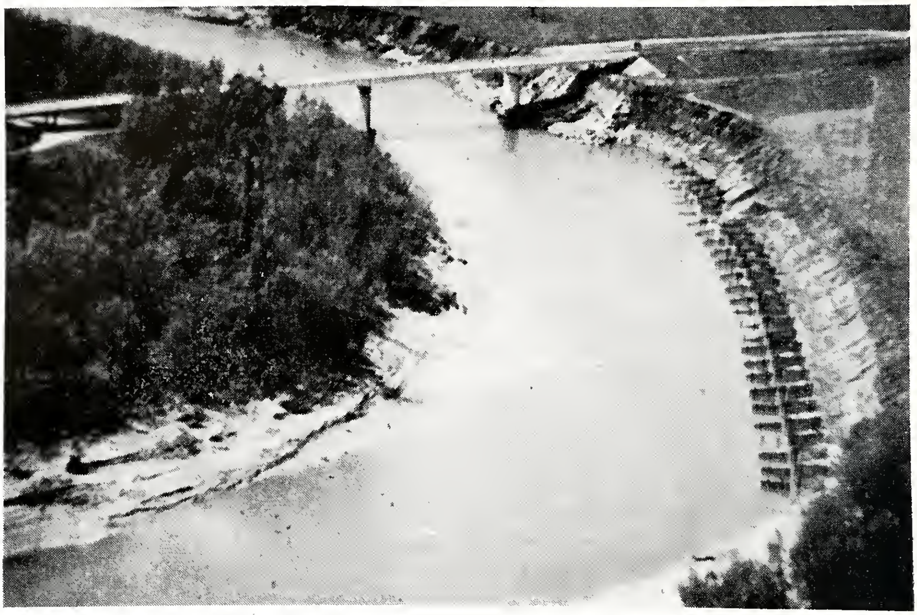
Once the system of jetties are in place, the river flow through the established control zone is significantly reduced in both velocity and volume. Because the jetties are permeable, sufficient flow is maintained to prevent eddy currents and backflow along the bank. The faster moving water arriving at the control zone cannot enter the zone because of the water already contained there, therefore, flows by the control zone outside of the jetties. The river currents, thereby, scour out a new thalweg more nearly in the middle of the channel and stabilize the water flow. Thus the buffer of "slow" water created by the jetty system prevents the faster, eroding current from coming in contact with the endangered area.

As the river flow is slowed through the control zone, silt and sediment in transport from upstream erosion is allowed to be redeposited. This sediment deposition silts in throughout the control zone and along the bank, re-establishing a more normal bank contour and vegetation growth. The extent of such restoration is dependent on the degree of sediment in transport in any given river and such restoration is considered a desirable side effect of the erosion control action but is **not**, repeat, not a necessary act to achieve erosion control.

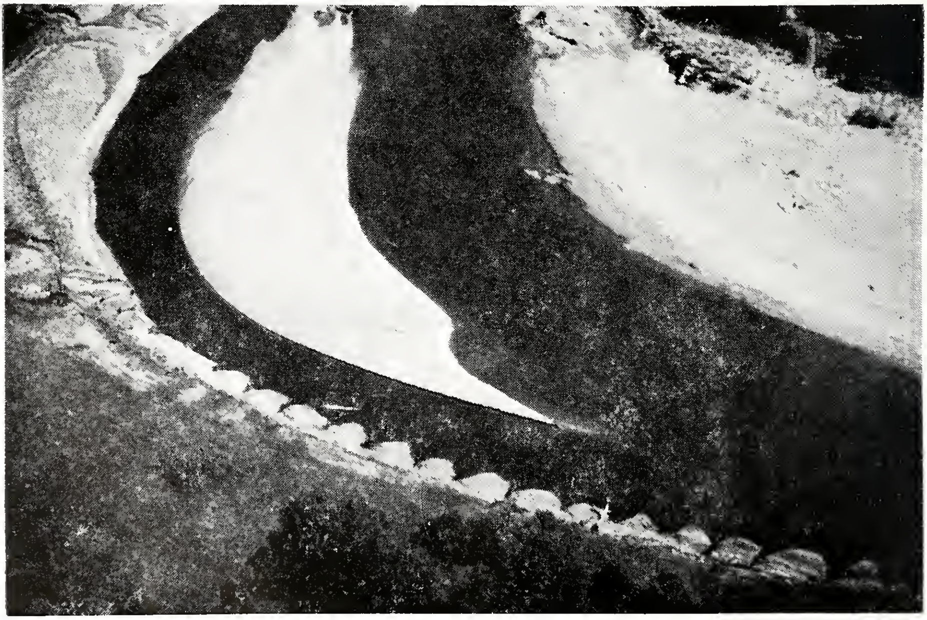
Hold That River is a full service engineering company. A specific problem is evaluated and the engineered solution is recommended in proposal format. The application of the design is accomplished as a turnkey project at a fixed price and the system performance is monitored for a period of at least five years to ensure desired results.

Actual experience has proven that river bank stabilization can be achieved through effective erosion control. Hold That River has proven that effective erosion control can be achieved by controlling the erosive forces of the river.

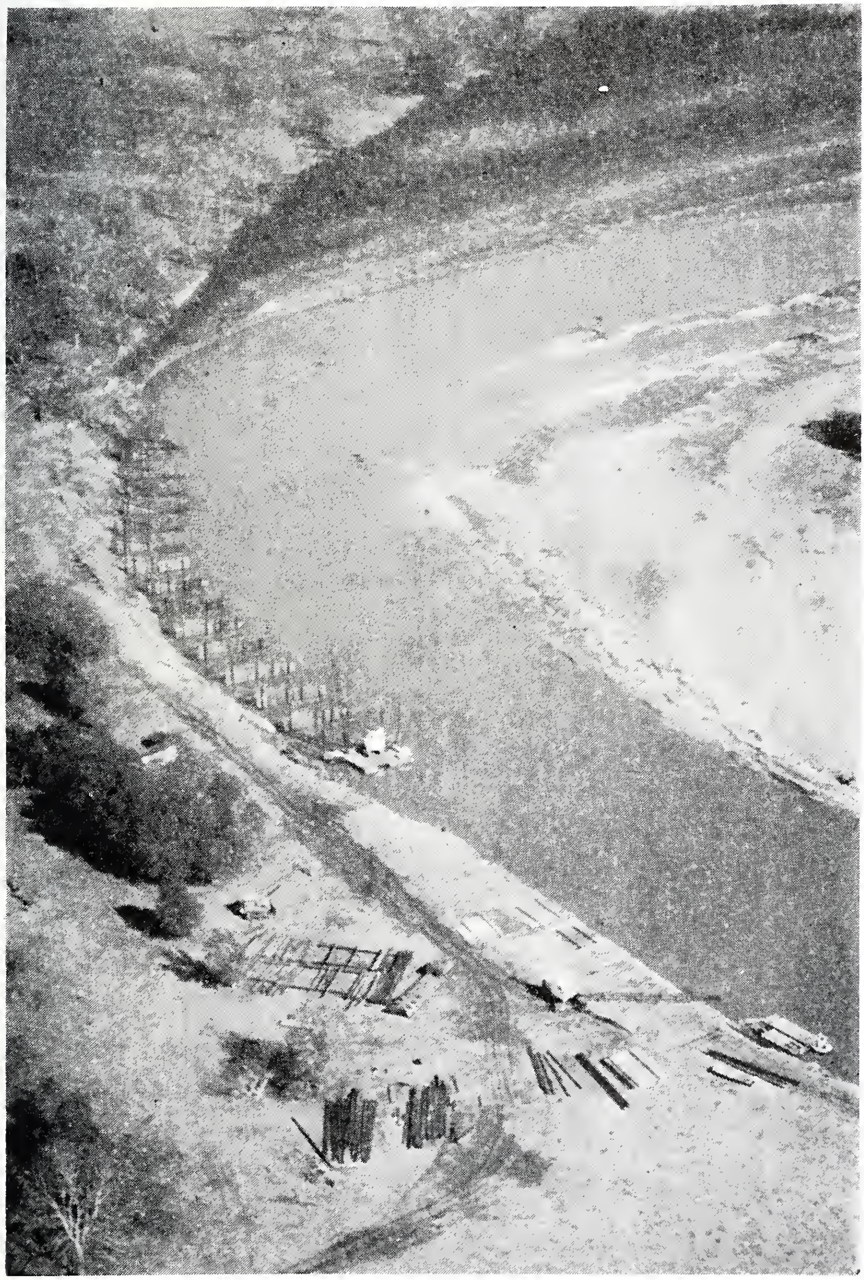
Mr. Burchett presented the following slides:



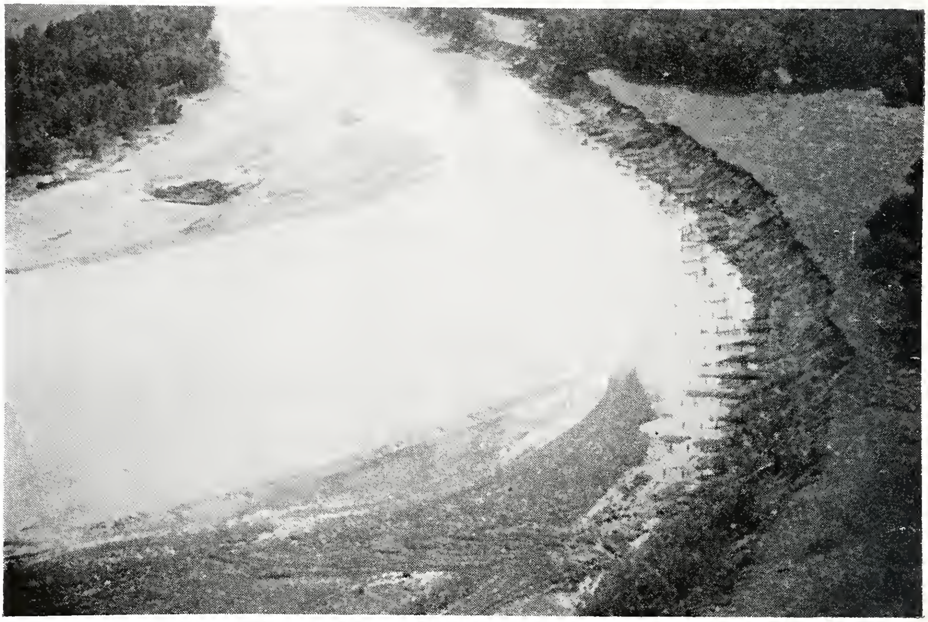
Jetty system installed to protect the Texas Highway Department bridge crossing the Brazos River on Highway 1462 near Rosharon, Texas.



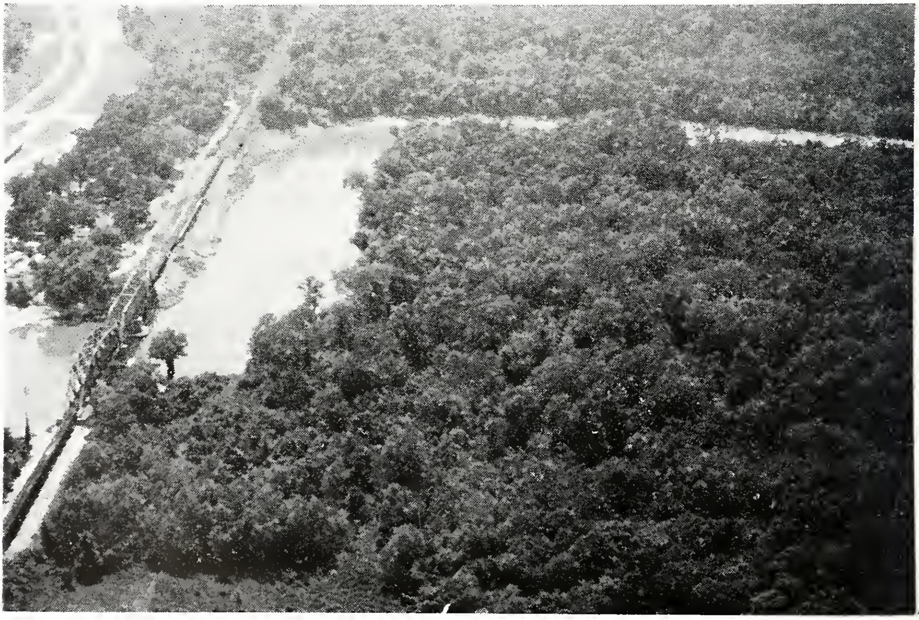
July, 1980, Brazos River near Sealy. Jetty system has created sufficient back pressure around bend to establish main channel away from the eroding bank.



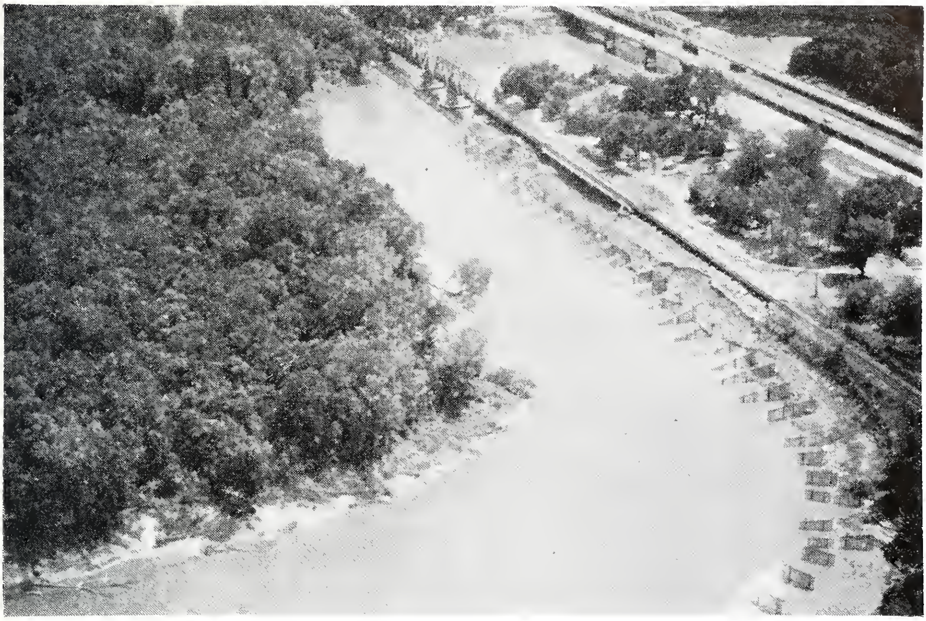
January, 1979, installation of jetty system on Brazos River near Sealy, Texas. Designed to protect pipeline crossing just downstream of the river bend.



Bank side channel of #3 (above) has completely silted in, stabilizing the main channel away from the endangered bank by August, 1981.



Southern Pacific Railroad Company's bridge crossing the Trinity River near Liberty, Texas, in early 1981. River tangent to roadbed has been eroding bank and endangering the tracks.



Railway erosion control system installed in August, 1981, Trinity River, Liberty, Texas.

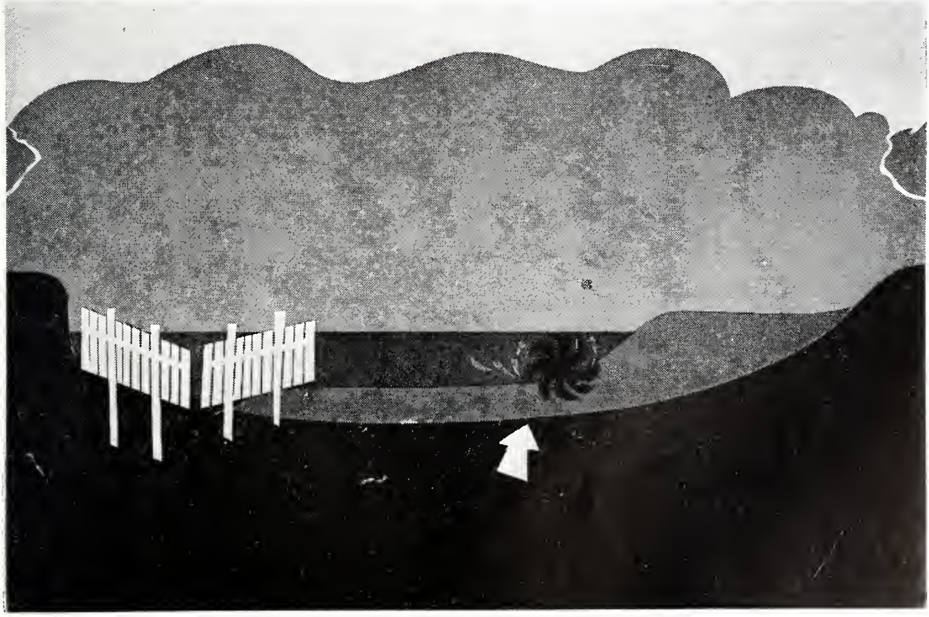


Illustration of Henson Permeable Spur Jetties installed in erosion zone of typical river cross section. Re-channeled current will erode away opposite bank sandbar to stabilize channel.

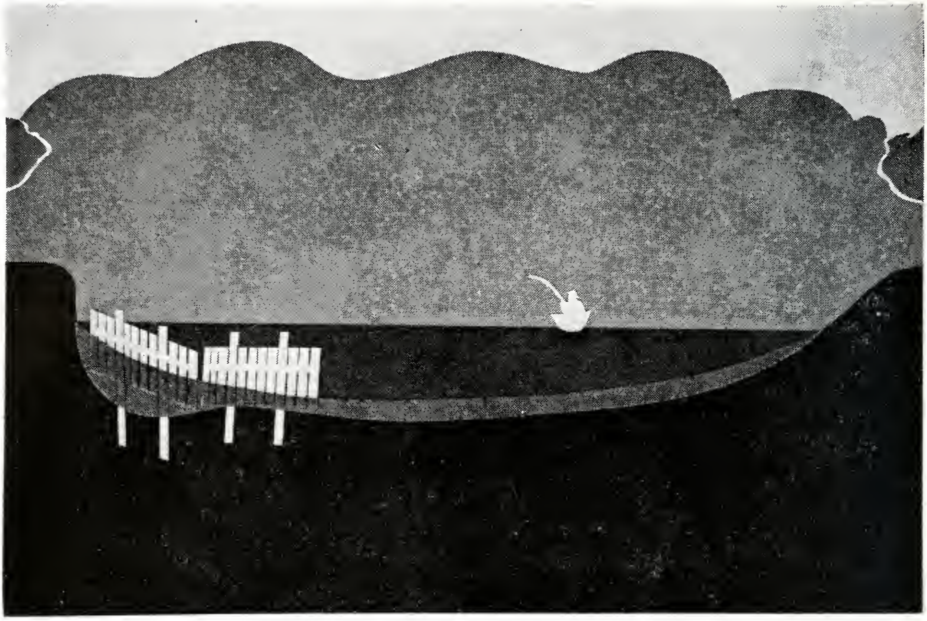


Illustration of typical river cross section after Henson Jetties have stabilized flow and silted in the prior eroding area, then protecting toe of bank.

President Chambers: Thank you, gentlemen for your very interesting contribution and your efforts on our behalf in presenting this report.

Mr. R. McMaster, Manager Facility & Structure of the B.&L.E. Railroad, Senior Vice President of the Association and Chairman of the Conference Program will introduce the next guest.

Mr. McMaster introduces Hunsberger.

Heavy High Rail for B&B Use

By JOHN HUNSBERGER

President, Traklease, Eighty Four, Pa.

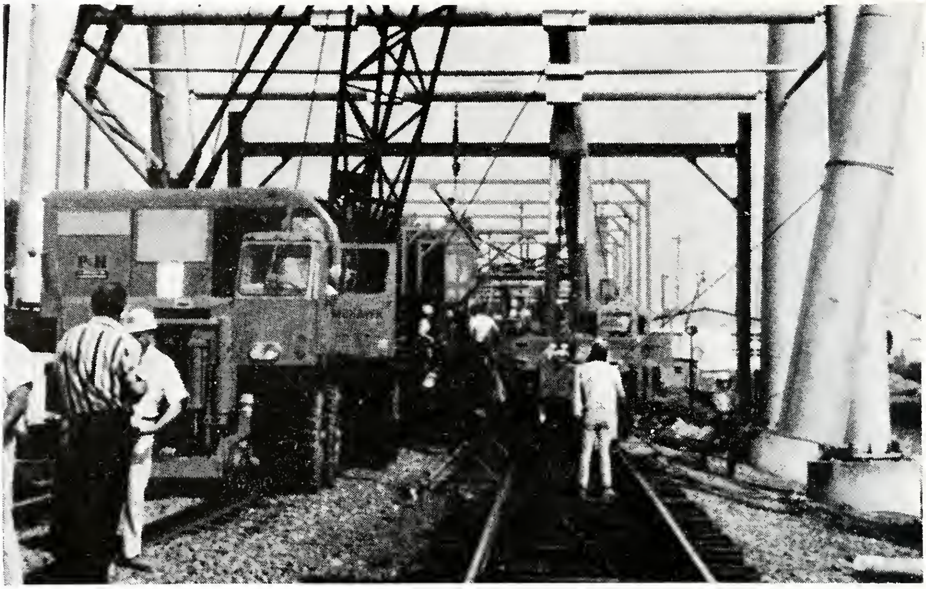
Good afternoon Members of the American Railway Bridge and Building Association. Thank you, Mr. McMasters, for the kind introduction. When I was approached by Mr. McMasters to talk to you gentlemen today, I felt then, and do now, more people were qualified for this subject . . . some of you are sitting in this room, right now. However, I seem to be the one up here, so I will carry on. I am going to make profound statements!

What Hi-Rail Is

Hi-rail equipment is so called because it can be operated on the highway or the railroad. The first equipment to be hi-railed were some of the first trucks that had their rubber tires removed. They were run on the rails on the rim. Then, rail wheels were bolted onto the axlehub. Most conventional hi-railed equipment have flanged rail wheels attached to rubber tired vehicles. These are raised and lowered by mechanical means or use of hydraulic or air cylinders. The reasons for the installation of rail wheels on rubber tired vehicles are many, depending upon the use. The most important thing gained is the versatility that allows the equipment to be used on the rail and also used on the ground. **This installation also opens up a variety of equipment that can be purchased at more competitive prices, as it is the same equipment used by the general construction industry.** Many patents have been issued for the conversion of rubber tired vehicles for rail movement. The flanged wheel, small version of the standard rail wheel, that can be raised and lowered, is the most prevalent one used. Patents for flanges that can be mounted by the tires when the tires are the same gage as the track, and patents for rollers that ride on both sides of the head of the rail, rollers for either side of the rail have been given. When the rubber tires do meet the head of the rail, flanged guide wheels are often used. These wheels take a percentage of the vehicle weight, the rubber tires carrying the rest, and driving tires of the vehicle being used for braking and traction. When the rubber tires do not conform to the gage of the track, the rail wheels will carry the entire vehicle's weight and the machine is propelled by friction of the rubber tires against the rail wheel and chain driven from the axle, by mechanical or hydraulic motor, and, also, the hydrostatic drive. In B & B use, quite a few hi-railed vehicles are used and are available.

The most frequent hi-rail vehicle seen is the inspection vehicle that has replaced the motor car. Cranes have been hi-railed for years. The first being the truck crane, and more recently, the hydraulic rough terrain crane. These cranes can be run on the rail to a remote bridge site, and then be removed from the tracks and put to work as necessary at the site.

Other vehicles used in B & B maintenance and construction are the painting trucks, the basket and high-reach trucks, the vacuum trucks, air compressors, self-propelled and tag-along, welding trucks, sand blasting trucks, Gradalls and excavating equipment. Cranes of all sorts have been hi-railed from 5-ton to 200-ton capacity. One of the most versatile of all trucks is a crew cab, with a crane of some sort mounted on it. This crane can be of a hydraulic articulated boom type or a straight boom. This piece of equipment can be used in the yard to load material, transport the men and material to the closest accessible railroad crossing to the work site,



Hi-Rail Vehicles Used.

and then, transport the men and materials, by rail, to the job site. The basket truck is being used for inspection, painting, and repairs at bridges. This truck gives you a mobile platform from which to work. Contractors that do bridge work, pile driving, painting, sand blasting, and structural erection, use mainly hi-rail equipment, since they have no railroad on which to move, on which to store their equipment after the job is completed, and, not all of their net jobs may be on the railroads.

Hi-Rail Equipment Used On Conrail Tracks

I have some slides and a short film showing some hi-rail equipment driving piling along the Conrail tracks in New Jersey. The extension of the electrification on this line was approved last year from South Amboy to Red Bank. The work was put out for bid, as the contractors had no rail equipment to do the work. Most of the line is through swamp and all of it fill so that access to it had to be made on the rails. The contractors already owned the rubber tired cranes and equipment, so the existing equipment was converted and hi-rail wheels were installed. The cans, or tubular piling, for the foundation of the catenary system had to be driven every 150 to 300 feet on both sides of the tracks. These cans varied in length from 15 to 90 feet. They were driven with a 5-ton, vibrating hydraulic hammer. A 75-ton P&H crane was, and is, being used with hydraulic self-propelled rail wheels. This enables the crane to move from site to site. Nine to ten cans a day could be driven, depending, of course, on the length of pile. The piles were excavated and filled with concrete.

These same cranes, hi-railed basket trucks, 15 and 20 ton hydraulic cranes are being used to install the catenary poles and catenary lines, as shown on the film and slides we will see shortly. A hi-railed crane, with a large rotary hole digger, is used to remove the earth from the cans. The film will show the driving of the 90 foot can, using two cranes. In the slides, we will see some sheet piling and a Poclain excavator removing earth from a sheet pile form.

Mr. Hunsberger showed slides and a film of this work.

President Chambers: Thank you gentlemen for a fine feature. Hi-rail transportation continues to improve. We appreciate your time and efforts.

Mr. J. W. Davidson, Asst. Director Bridge Engineer, B.N. and a director of the Association will introduce the participants in the next feature, a panel discussion on training for B. & B. Foremen.

Mr. Davidson and panel.

Bridges and Structures Training Program

REPORT OF STANDING COMMITTEE NO. 3

J. W. DAVIDSON, *Moderator*; G. W. VOGEN, CN; G. BURGESS, Chessie System.

(*Presented by* G. W. VOGEN)

J. W. Davidson

The purpose of my presentation today is to provide information on the training program we have at CN Rail for our Bridges and Structures forces.

The program has been operational since May 4th of this year, and in the development stage for a full year previous to that.

We are currently training all line supervisory staff, and will commence with the schedule forces on November 2 upcoming.

The program is covered by a formal agreement with the Brotherhood Maintenance of Way Employees. Instruction will be conducted on a year round, continuing basis, in specially constructed facilities, utilizing trained instructors and modern teaching techniques.

Examinations are given. Pay rates and promotions are tied to success in the training. Penalties for failure for new employees hired after the effective date of the program are made but older employees are protected.

In the Engineering Function we currently have full training programs for Signals, Track Mtce, Track Welding, and Work Equipment Mechanics. The administration of the Bridge and Structures Program is along similar lines to these other programs but, of course, the subject matter is unique to, and designed specifically to meet the needs of our Bridges and Structures forces.

Just a brief mention here about our use of the title "Bridges and Structures." A few years ago we re-named the Bridge and Building Department to Bridges and Structures, a more fully encompassing term as our Steel Bridge and Masonry gang workers are included.

I will cover the training program, its content, and administration in detail but first I would like to mention a few pertinent facts about Canadian National.

Some Facts About Canadian National

Canadian National Railways operates in all 10 Canadian Provinces, the Northwest Territories, and in eleven States in the U.S. Canada is an officially bilingual country, and our employees may work in either the French and English language determined mainly by geographic location and the language predominating therein.

CN Rail, of which we are a part, is

a Division of Canadian National Railways, with its own President responsible for the operation and profitability of the Division.

The CN System is divided into five operating Regions on geographic lines, along with our associate, the Grand Trunk Western Railroad, each with its own Vice-President, Chief or Regional Chief Engineer and other functional staff.

System Headquarters is at Montreal, where the Chief Engineer and his staff reports through the Vice-President Operations to the President, CN Rail.

We are monitored by a Federal group, known as the R.T.C.—The Railway Transport Committee, who sit at Ottawa, the national Capital. This group roughly equates to your I.C.

CN operates over approximately 25,000 miles of main track, of which about 1700 miles are in the U.S.A.

The Engineering staff consists of about 13,000 people, all told, of which about 2,000 are management and support staff. About 55 line supervisory positions are within the Bridges and Structures group, and we have approximately 1,542 B & S employees.

Being a transcontinental railway, our employees encounter all the difficulties in working conditions associated with the different geographical regions. We are no strangers to extremes of heat and cold, isolation, rushing rivers, mountains, prairies, and dense forests. We encounter swamp, and desert conditions, and even deal with perma-frost in the far North. Our employees must be versatile and diverse, and so must be their training.

Training Is Not New

Training is not new in our Bridges and Structures Department. In the late 1950's a B & B Foreman's training course was conducted in Winnipeg, Manitoba. Although this course was extremely well given, thorough, and successfully achieved its purpose, it gradually fell into disuse, once the majority of the Foremen had attended.

The program had a number of limitations for no training was given for promotion, juniors were not included, and insufficient numbers of employees could be trained. Facilities were not permanently assigned nor were they adequate to handle the large number of employees involved.

As the 60's progressed, a series of pressures began to build due to budgetary constraints, technological developments, mechanization, re-organizations and attrition, which culminated in the 70's in a situation wherein we faced a declining and aging work force, and an increasing turnover rate in the more junior employees who should have been learning and gaining experience.

The conditions were similar in other Maintenance of Way groups such as Track Maintenance and Welding.

This all began to turn around with the signing on March 4, 1976 of a letter of understanding between the Brotherhood of Maintenance of Way Employees and the Railway Association of Canada which represents the major Railways in Canada. The letter called for an in-depth review to determine further steps leading to the establishment and introduction of a formal training program.

As a result a Track Training program was developed and commenced in January 1978. Implementation of a new rail maintenance program increased the need for Track Welders, and this Training program was prepared and implemented in September 1979.

Also in 1979, we advised the Brotherhood of Maintenance of Way employees of our commitment to a training program for B & S employees.

Study Team Helped Program To be Developed

To enable the program to be developed, we conducted what we term a front end analysis, in which a study team assigned for the purpose examined in depth, and reported on the following items.

—Identification of training needs (who, what)

—Course content and duration
—Priority & Scheduling of Training
—Qualification and Examinations
—Incentives and penalties
—Instructor requirements & training facilities
—Course Development and Administration
—Program operation and costs

I cannot overemphasize the importance of thorough front end analysis, as it is on this documentation that the program is planned and communicated to management for authorities, and around which the covering agreement terms are negotiated. It also serves as the basis upon which guidelines and directives for the development of the program are formulated.

To gather data the study team visited all five Regions, and in addition compared experiences with five (5) other Railroads in the United States and Canada. Comparison of wages, training, and working conditions were also made with the Construction industry and various Federal and Provincial Government Agencies. Results of seminars with Bridges & Structures Supervisors were used to establish subject priorities.

Length and content of several typical training subjects were tested through a series of 2 week pilot courses for B & B Foremen across the System. The evaluation of these courses provided useful insight into the employees needs and attitudes towards training.

A meeting was held with the B.M.W.E. Representatives to explore their views which were presented and discussed in detail.

A joint meeting was held with the Regional Bridges and Structures Engineers with senior System Engineering officers attending. These meetings provided the overall direction on training needs and benefits to be achieved, and provided direction regarding the Union proposals, outside survey results, training incentives, subject content, location of schools, and the rate and manner in which the training would be conducted.

A final meeting was then held with the Brotherhood to further update them on the development proposals and to further discuss their views.

Detailed Training Standards Prepared

The study group identified approximately fifty-seven subjects and prepared detailed training standards and specifications for each subject. These specifications formed the guide to be used by course writers in preparing the instruction materials, and for the training staff in the planning of course content.

The specifications delineate and describe by subject:

—the learning objective to be achieved by the student;
—the main points of the lesson content;
—methods of instruction to be used;
—training aids and references required;
—instructor qualification requirements;
—duration of the lesson;
—student pre-knowledge;
—method of evaluating student learning.

The group also developed samples of lesson plans and student handouts, examinations, classroom timetables, training equipment lists, and identified which category of employee should be trained in which subjects.

The findings and recommendations of the study group were presented to management and to the B.M.W.E. representatives. Brotherhood agreement in principle was received at this stage and program development was begun in earnest.

Staff Assigned to Prepare Training Materials

To do the actual job of writing and preparing the training materials, the necessary staff was assigned to work on a project basis under the direction of the Co-ordinator of Training. Three full time lesson writers and three illustrators were assigned. Because we have two official languages in Canada, French and English, it was necessary to add translators to the group. One B & S Engineer, and two B & B Masters were used to write lessons.

Regional contributions and consultation was sought in all phases of the study and program development, to ensure the ultimate program would effectively meet the Regional needs.

While the lesson materials were being prepared, the design, construction, and acquisition, of training aids, school facilities and equipment was underway, as was the very important task of selecting and training instructors.

Selection of Instructors

It is important to make note here of the factors involved in Instructor selection. The success of this process is critical as upon the instructors rests the eventual success or failure of any training program. We selected only experienced B & S employees with potential for development (four B & B Masters and one experienced Foreman). The Instructor position is not a dead end job, and ideally is considered a development position for the persons assigned.

Applicants were given intensive screening, and successful candidates were then trained for two weeks in the techniques of instructing. Only then was the final selection of individuals and appointments made.

Agreement Signed

In January of 1981 formal training agreement negotiations were commenced to develop the rules under which the program would operate, and on 27 March, our efforts culminated in the signing of an agreement between the Railway and the B.M.W.E. The agreement provides for:

- a formal training program;
- a new wage structure contingent upon completion of training; and
- the rules and terms under which the program will operate.

Program Begins

The Bridges and Structures Training Program was officially inaugurated on 4 May, 1981 with the commencement of classes at Transcona, Man. attended by supervisors from each Region. The first schedule employees will attend on 2 November of this year.

An important feature of the Program is that all supervisory personnel be exposed to the training prior to their employees. The main objective is to acquaint them with the subject matter and methods used to train their employees, and to take advantage of their experience and knowledge to evaluate the lesson materials before giving them to the schedule forces.

The training requires incumbent employees, those in service prior to 1 May 1981, to qualify in their existing positions to be eligible to receive a higher after training incentive rate. No penalty is given for failure by incumbents, but they are required to take the training and must pass in their existing classification to be eligible to take further training for promotion.

New employees, that is, those hired after the effective date of the training program, must qualify to the Bridgeman's level within the first two years of service in order to remain in service. Thereafter they must qualify to be eligible for promotions.

As pay rates are tied to the training it is important that employees be trained as much as possible in order of seniority in their classification. Attendance schedules are formulated keeping seniority order in mind, commencing with classes for existing Foremen as the highest classification. Carpenters, Steelworkers, and Masonry Workers would be next, followed by Bridgemen.

The training will cover approximately 1161 of the 1542 employees in the Bridges and Structures Department, and will include all B & B forces, Masonry Workers, Steel Bridge Workers and Painters.

Not covered are government certified Tradesmen such as Plumbers, Electricians, Pump Repairmen, and Pipefitter, as these positions are normally hired with full qualifications. However, training at a recognized trade school with suitable on-the-job experience may be arranged at the Regional level if required on an individual need basis.

Positions such as Bricklayers, Masons, B & B Welders, Tinsmiths, Bench Carpenters, Plasterers, and Blacksmiths do not require government certification, and need only meet the qualifications of the Railway. In most instances successful applicants to a non-government certified tradesman's position will have gained sufficient experience to qualify by helping a tradesman while working on the job.

Tradesman training then will be limited to short courses in selected railway subjects such as rules, safety, or perhaps in response to specific technological changes affecting their work.

No training will be given to Bridgetenders who now qualify under existing government regulations, nor to one hundred fifty-eight employees in other classifications such as Truck Drivers, Janitors, and gang cooks.

Regular rates of pay apply during the training. However, as an incentive, higher rates apply immediately for incumbent employees who successfully complete the course for their respective jobs.

Schedule Of Courses

For incumbent employees:

Present Foremen and Assistants
— 6 weeks (2 visits of 3 weeks)
Carpenters
— 5 weeks (3 & 2)
Steelworkers
— 4 weeks (2 & 2)
Masonry workers
— 4 weeks (2 & 2)
Bridgemen
— 4 weeks (2 & 2)

New employees

0-6 months service
— 4 hours induction and
— on-the-job training by the Foreman which should be completed in six months.

To be Bridgemen
— 4 weeks (2 & 2)
Steel worker
— 4 weeks (2 & 2)
Masonry worker
— 4 weeks (2 & 2)

Promotions

Carpenter
— 1 week + 4 wks Bridgeman Level
Foreman
— 1 week

57 lessons have been developed, and are in general categories as follows:

Rules related subjects
Leadership, Planning & Organizing
Use of tools & equipment
Basic Carpentry
Pile Driving
Steel Bridges
Timber Trestles
Culverts
Concrete & Masonry Work

Subjects Based on Need of Worker

The subjects are based mainly on the identified needs for B & B Foremen, Carpenters, & Bridgemen. Masonry Workers, Steel Bridge Workers, and Painters will receive only those of the 57 subjects that are applicable to all categories. Subjects not applicable to Steel Bridge or Masonry work would be eliminated, e.g., timber inspection, roofing & flashing, etc., and would be replaced with other more pertinent subjects.

Safety is not treated as a special subject but is emphasized throughout the course as it pertains to each lesson as it is being taught.

Each category of employee will receive only the subjects that enable him to do his job. Foremen would receive all subjects as well as Planning and Organizing Work, Leadership, How to Train Others, etc. While Bridgemen would learn about Use of Tools, Tackle & Rigging, Pile Drivers, Bridge Framing, Culvert Installation, but would stop short of subjects identified specifically for the higher classifications of Carpenter and Foreman, receiving these subjects at a later time in their career when they apply for and are being trained for promotion. The same principles apply in selection of subjects for Steel Bridge, and Masonry Workers.

Newly hired employees will be given a few hours introduction to the job which describes:

Safety—Rules and Regulations.
Organization—The railway, Maintenance of Way, and Bridges and Structures.
Description of the job and working conditions.
Basic tools and materials.
Salary and benefit plans.
B.M.W.E. Agreement.
Their line of promotion.
Their Training Responsibilities and other items as appropriate.

The introduction to the job will be presented through an audio-visual slide presentation which may be given at a Central location or in the field by the Foreman or Supervisor. The Foreman will play an important role in getting the new man started.

CN Rail has gone all out to provide the best facilities possible.

Two schools will be used, located geographically where they will provide ready access to the largest number of employees.

The schools, of modern construction, and architecturally designed specifically for training of Engineering personnel are located at:

Transcona, Man.

- For English speaking employees At this institution facilities will be for twenty-four students (two classes of twelve) with four Instructors.
- The second school located at Charny, Quebec is for French speaking employees. Due to their lesser numbers will consist of one class of six employees and one Instructor.

Note: Student/Instructor ratio is one Instructor per six students. This ratio is necessary to allow for practical demonstrations where one Instructor is not effective with more than six students.

At the school at Charny, Quebec the B & S workshop and the Track Training Workshop will share the same building, but have separate sectioned off areas. A similar facility is provided at Transcona.

At the school lectures are given by the Instructors, but they are kept to a minimum. The instruction is designed to be as practical as possible with emphasis on student involvement and active participation in demonstrations. The instructors are experienced B & B Masters and/or Foremen carefully selected and trained for two weeks in techniques of instructing.

Classroom lectures use modern teaching aids and up-to-date techniques to keep the instruction interesting.

Frequent demonstrations, discussions, and question-and-answer periods are supplemented with in-field visits and workshop demonstrations and projects.

Students will practice what they are taught by performing actual tasks such as rafter framing, construction of small buildings, use of small power tools, taking line-ups, etc.

To help them prepare for examinations, and for future reference on the job, student handouts are provided. They are clearly worded, amply illustrated with easily understood drawings, photographs and sketches. Handouts and instruction are available in French and English.

Examinations are designed so that no long, written answers are required. Many of the tests are practical where students demonstrate that they can do the job. In some cases oral answers are acceptable.

Students are given one opportunity to re-take an examination in event of failure. A new employee is released from service if any exam is failed twice. Regular employees would not receive the pay increase for their classification, and are only considered for further testing on their own time. The agreement does contain a procedure for appeal.

Schools Well Equipped

The schools are live-in, modern, with

comfortable single bedrooms.

Ample recreation area.

- Checkers
- Shuffleboard
- Billiards
- Reading/TV Room
- Outdoor Lawn Facilities
- Ping Pong

A Cafeteria for meal service is by contract caterer. Nearby motels handle the overflow for the first four years, at which time the schools will be completely self-sufficient.

Each school is equipped with a variety of tools & equipment which is located in a workshop building providing weather protection for year round operation.

The schools are fully equipped with vehicles to transport men and equipment, and are accessible to Work Equipment.

Extent of Training

To give an idea of the extent of the training, eleven hundred sixty-one incumbent employees are to be trained in their present classifications and for promotion, and all new employees as they are hired. Training of incumbents is expected to be completed in approximately four and one-half years, at which time the on-going training should be reduced to about fifty per cent of the current workload.

Thirty students will be in training at any given time. The schools will operate ten months per year. The 1981 program will total eighty persons, of which fifty-four will be Supervisors and B & B Masters, the remainder will be Foremen. The 1982 projected workload will include completion of the remaining one hundred twenty-three Foremen, as well as a start on the other classifications.

Before starting the training of schedule employees communication is needed and explanation of the program details to the employees to allay any fears they might have, and to enlist their support and co-operation. To do this it is proposed to use a one hour audio-visual slide presentation as the information vehicle.

When introducing other training programs a similar presentation was used, which was prepared jointly by a Management-Union committee.

A Successful Cooperative Effort

The results of these information presentations were highly successful, and certainly a tribute to the cooperative effort of both Management and Union in meeting the objective. Valid suggestions were received from employees and supervisors. Employee concerns and fears about the training were satisfactorily allayed, and more importantly, the active role of the General Chairmen gave evidence of full Brotherhood support and commitment to the training programs being introduced. It is expected similar results will be achieved when introducing and explaining the program to the B & S schedule forces.

From start to finish the Brotherhood of Maintenance of Way Employees has played a full role. Their representatives have given Management their full support and have been kept fully informed at each stage of development and implementation of the program. They have come forward with a number of suggestions, and comments that have led to improvements in the training. We value their support and feel it has been a major factor in allowing us to achieve the degree of success that has been attained. We look forward to continuing that success.

We know that a trained employee is an improved employee in many areas which may be summed up under the terms "productivity," and "safety" — The goals of our training.

Thank you.

President Chambers: Thank you gentlemen for your efforts, we appreciate your contribution. Competent foremen in the Bridge & Building departments are frequently hard to find.

That concludes this afternoon's session.

The joint session reconvenes tomorrow at 9:00 a.m. and the B. & B. session reconvenes here at 1:00 p.m.

TUESDAY MORNING JOINT SESSION

September 15, 1981

The Joint Session of the Roadmasters and Maintenance of Way Association and American Railway Bridge & Building Association was called to order on Tuesday Morning, September 15, 1981, at 9:05 o'clock, Mr. J. W. Chambers, President of B & B, presiding.

President Chambers: Will the second Joint Session of the Roadmasters and Maintenance of Way Association and the American Railway Bridge & Building Association come to order?

Ladies and gentlemen, members and guests, on behalf of the Roadmasters and Bridge & Building Association, I welcome you to the second Joint Session of this Conference.

The registration this morning is, Roadmasters, 247 — Bridge & Building, 99 — guests, 117 — Associate, 224 — and ladies, 105 — for a total of, other than ladies, 687.

Now, at this time I would like to present to you some of the members of the Executive Committee. Will the gentlemen please stand as their names are called and remain standing until all are introduced? Please withhold your applause until all are introduced.

Mr. D. J. Lewis, Director. He is a designer with the I.C.G. Railroad. He is not present, I guess.

Mr. J. T. Kapp, Director, Project Engineer, ConRail.

Mr. O. D. Anthony, Director, Assistant Chief Engineer, Bridges & Structures, Bangor & Aroostook Railroad.

Mr. C. M. Russell, Director, B & B Supervisor, Southern.

We will skip the next gentleman for now.

Mr. O. C. Denz, Jr., Vice President, Supervisor, Building Maintenance, Chicago, Milwaukee, St. Paul & Pacific Railroad.

I will also skip the next gentleman.

Mr. Jim Michel, Director, Manager, Engineering Design, Amtrak.

I will skip the next gentleman.

The next man is Mr. W. R. Hyma, Junior Vice President, Bridge Engineer, System, Atchison, Topeka & Santa Fe.

Next man is Mr. R. C. McMaster, Senior Vice President, Manager of Facilities and Structures, B. & L.E. Railroad.

I will skip the next gentleman for right now. You may applaud. (Applause)

Mr. Sorrels, do you have any further introductions to make?

President Sorrels: Thank you, Mr. Chambers.

At this time I would like to introduce to you the members of the Roadmasters Executive Committee who worked very hard to make this Conference possible. As I introduce you, will you please stand and remain standing until all have been introduced? Please withhold your applause until all have been introduced.

Mr. B. H. Price, Sr., Director, Development Engineer, B.&L.E.

Mr. D. E. Staplin, Director, Director of Planning, Family Lines.

Mr. H. C. Lewandowski, Director, General Roadmaster, Milwaukee.

Mr. C. D. Barton, Director, Chief Engineer, MoPac.

Mr. H. V. Meek, General Roadmaster, D.&R.G.W., Director.

Mr. R. E. Snyder, Director, Director of Maintenance Operations, C.&N.W.

Mr. M. B. Mitchell, Treasurer, Assistant Division Engineer, Southern.

Mr. R. V. Hernandez, 2nd Vice President, Track Production Manager, S.P.

Mr. K. W. Sutherland, 1st Vice President, Superintendent Systems, Maintenance of Way, CP Rail.

You may now applaud. (Applause)

I would like to turn the rostrum back to President Chambers.

President Chambers: Thank you, Mr. Sorrels.

It is an honor and a pleasure to introduce the Keynote Speaker at this Joint Session of our Association's Eighty-sixth Annual Meeting.

James W. Gessner was elected President and Chief Executive Officer of the Missouri Pacific Railroad in May, 1979, after having served as President since May, 1978.

The bulk of his career has been devoted to railroad operations and has covered a wide range of assignments.

Mr. Gessner joined the Missouri Pacific Railroad in 1969 as Assistant to the Vice President of Operations in St. Louis.

Two years later he was named General Manager of the Missouri Pacific's Eastern District, with headquarters in Little Rock. He then returned to St. Louis as General Manager of Transportation.

In March, 1974, Mr. Gessner was elected Vice President of Operations and was elected Executive Vice President in September, 1976.

Mr. Gessner began his railroad career in 1955 with the Southern Railway, after earning both a Bachelor's degree and a Master's degree in Civil Engineering at the University of Michigan at Ann Arbor.

He served in the U.S. Army from 1952 to 1954.

With the Southern, Mr. Gessner served in the positions of Track Supervisor, Assistant Train Master, Train Master, Superintendent, Manager, Customer Services Engineering, Director, Transportation Engineering, and Director of Planning and Development.

Mr. Gessner supports this organization and others in that participation is encouraged. We have a large contingent of Missouri Pacific Railroad Officers who attend the B & B Conference each year.

I am pleased to present the President and Chief Executive Officer of the Missouri Pacific Railroad, Mr. J. W. Gessner. (Applause)

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Increasing Productivity

By J. W. GESSNER

President, Missouri Pacific, St. Louis, Mo.

Thank you, Mr. Chambers, ladies and gentlemen:

As a fellow engineer, I have especially warm feelings about being here today. We engineers have a special affinity towards one another. In college you could always identify a fellow engineering student by the slide rule encased in a leather holster ensemble dangling from his belt. This vaguely western touch to our daily ensemble would draw jibes from the non-engineer about whom of us might be "the fastest rule in the school."

Now that the slide rule has given way to the pocket calculator, another item frequently carried in holsters, I wonder how today's engineering student distinguish their counterparts? For the ubiquitous calculator might even be the tool of the English major or the Lit School student plowing through a basic math course.

Confused identity for most of you is commonplace. You are always being cast as the fellows who run the locomotives. The son of a railroad Civil Engineer tells his friends, "My Daddy is a Railroad Engineer," and forever more the kids think he is a modern day version of Casey Jones.

Perhaps the Engineering Profession should lobby for a change of title of the locomotive engineer to something like "train driver," or, "train pilot." Nomenclature notwithstanding, you are the builders and the guardians of the basic elements of the railroad upon which everything else in railroading depends. Frequently, your structures exist for scores of years after your passing from this world. Few and privileged are those who have the opportunity to leave monuments as testimony to their careers, even though the structures may not bear your names.

J. W. Gessner

Engineering a Career for Pride and Satisfaction

Yours is a career with enormous potential for pride and satisfaction beyond that of rank and monetary reward. As Sam Rayburn once said, "Any jackass can kick down a barn, but it takes a craftsman to build one." The builders are the true heroes of railroad history, for they were the people who battled harsh weather, hostile Indians, injury and illness to push the railroads across the nation.

I imagine that you, responsible for track, take special pride in the driving of the golden spike at Promontory, Utah, in 1869, marking completion of the transcontinental route. That is certainly an auspicious moment in history heralded many times.

The bridge people, too, have a great symbol to point to, even though it may not be as well known. That is the completion of the Eades Bridge across the Mississippi River in St. Louis in 1874, not only one of the great engineering feats of the time, but also one of the spans that made possible the joining of the East and the West by rail.

The golden spike now resides in a museum, but the Eades Bridge still stands, serving a useful life and purpose.

Difficult to Find Topic on Which to Speak

Today it is my privilege to address an assembly which has brought together railroad people from east and west and north and south, for ours is a unified industry, both competitive and cooperative.

In preparing for today, considerable thought was given to what might be said that would be of common interest. A review of addresses of past several meetings show that several speakers addressed broad industry issues, such as competitive equity, legislation, and the future of the industry. It was tempting, too, to discuss railroad engineering per se, for that has always been an area of intense interest to me.

I am reminded, however, of the old-timer who survived the great Johnstown flood, but eventually arrived at the Pearly Gates due to natural causes. St. Peter asked the old-timer what special favor he might desire. He told St. Peter that he would like to gather everyone in a big Heavenly arena and recount his experiences in the Johnstown flood. St. Peter said that could be arranged, but, "Remember, Noah will be in the audience."

Thus, I will pass on making an engineering presentation, knowing many Noahs are among you this morning and more to follow on your program.

One topic, however, that I believe is of concern to all of us is productivity. The lack of productivity in America is a disgrace and a problem of deep concern across all sectors of our economy. Simply defined, productivity is a measure of output per hour worked, and it measures how effectively a society uses its people, physical resources, capital and tools. Corrected for inflation, it is a true measure of economic progress.

Productivity in the United States Poor

The United States ranks last among the leading industrial nations of the world in terms of productivity growth, averaging only 2.6% annually from 1960 to 1977. During that same period, Japan averaged 8.8%; France, 5.7%; West Germany, 5.5%. Since then, U.S. productivity has slid further, barely breaking even and sometimes registering a decline growth, as it did in 1979.

The causes of poor productivity are many, and they include lagging capital investments, idle machinery and inventory, punitive government regulations, labor restrictions and quite importantly, inattention on the part of management. Worker attitudes are also an important factor.

In fairness, and at the risk of making an apple versus orange comparison, it seems that railroad productivity in the U.S. is better than that for the manufacturing sector as a whole. Railroad productivity, in terms of revenue ton miles per manhour, averaged gains of 5.3% for the years 1970 through 1977. A volume operation of the magnitude of railroad transportation should be highly productive, so I take little comfort in these comparisons.

Engineer Uses Three Basic Elements of Productivity

Many elements in the productivity matrix are beyond the control of the railroad engineer and maintenance people, such as the generation of capital and negotiation of labor contracts. But, the railroad engineer does utilize three basic elements of productivity — money, materials and manpower. Engineering, on average accounts for 19% of railroad manpower, and operating expenses, and as much as one-third of capital investments.

Obviously, management skills are of paramount importance to the engineer in utilizing to maximum efficiency the resources provided. Few engineers enter college with the thought that they must not only develop the technical skills of their profession, but also the managerial skills of a business man. Nor do our schools do much to prepare the engineer for the two-fold role in industry. Despite that, the engineers who rise to management positions learn through experience how to utilize money, materials and manpower. Moreover, their ability to do so can be measured in highly finite ways.

While management skills may be lightly treated in the formal education of an engineer, it is even more apparent that people skills are barely touched upon, not only in the engineering sciences, but in virtually all areas of education. By people skills, I mean the art of drawing upon the full potential of the people you manage, developing within that group a sense of motivation and pride.

And here I would like to add one caution. Real motivation cannot be externally induced. It must come from within. A sense of self-control in relation to achievement and the recognition to go with responsibility, decision-making, goal-sharing, growth and knowledge, and from the work itself. People with pride and motivation are people who are productive. And increased productivity equals increased profitability.

The Japanese lead the world in productivity and the primary reason for this leadership is a highly motivated and productive work force.

Delta Airlines is the airline leader in profitability. According to a recent story in Business Week, the reason for Delta's profitability are management discipline in adhering to long-range plans and, as you might guess, the most productive workers in the industry.

People Need Proper Motivation

It is fashionable to lament the demise of the work ethics in America, to point out that most workers interpret "work smart" to mean — "see how many hours you can waste." Both contentions seem too broad a generalization. People properly motivated can move mountains, and move them willingly. We see the principle at work every week-end in the football season, when the underdog, undermanned teams, trample the favorites.

While it hurts me deeply to mention this, the victory of Wisconsin over Michigan last Saturday was a good example. Those were motivated people!

The potential of the human being, whether mental or physical, is awesome to contemplate. The work ethic is not dead — just too often dormant. It is our responsibility as managers to rekindle that dormant flame and fan it into an outburst of productivity. Management consultant, Peter Drucker, tells us that productivity is the first test of management competence. Mr. Drucker, and other management experts, and psychologists, provide numerous theoretical approaches to gain more employee productivity. I realize that theory and practice are often far removed from one another in the pressure of the daily job. But, these writers have convinced me that people skills can be learned. They are not necessarily intuitive. It is not my purpose to appear before you as another expert on the management of people. I can, however, share with you some general observations and anecdotes to illustrate these observations. Most of the anecdotes concern true events on the Missouri Pacific, with which I am acquainted.

I do not wish to imply in using these examples that Missouri Pacific is a paragon in the area of motivation of productivity. We, like everyone else, have a substantial area for improvement.

Must Find Out What Worker Considers Important in Job Satisfaction

A starting point in our endeavor to learn more about motivating people might be to discover what the worker considers important in achieving job satisfaction.

More than seven hundred supervisors in twenty-four large companies were asked to rate ten morale factors in the order they thought their employees would rate them. Wages, job security, and the opportunity for promotion topped the survey of the supervisors. Now, remember, this is the supervisors identifying what they thought the worker would identify.

At the bottom of the list were appreciation for work done; sympathetic help on personal problems; and a feeling of being "in" on things.

Then the same survey was conducted among thirty-four thousand employees. On the employee survey, job security was only fourth, while wages ranked fifth, and opportunity for promotion ranked seventh. Guess what ranked one, two and three? Appreciation for work done, No. 1; a feeling of "being in on things," No. 2; and sympathetic help on personal problems, No. 3.

Why People Work

Now, let us address some of the basic assumptions about people who work for us. We have, of course, exceptions to these, but in the main I believe them to be true.

First, people like to work. That seems to be particularly true of railroad people. All of us know dozens of railroad people who retire from their companies and then fret about having nothing worthwhile to do. I suspect the same to be true of active railroad workers faced with more than a brief stretch of inactivity.

You may recall an event that happened several years ago when the Burlington-Northern was formed. The BN wound up with sixty-one employees in Chicago, mostly young women who were guaranteed full pay even though no work was available for them to perform. They reported to an office each day and they were free to do anything reasonable they wished — play cards, read, knit, stare out the window, whatever. Within a few days the group had dubbed itself "The Prisoners of Cell Block 101," and they were appealing to the press to help them out of this terrible non-working environment.

Secondly, people are motivated by competition and by acknowledgement of superior performance. A few years ago we combined many of our track gangs into fewer, but larger and better equipped crews. We anticipated that a typical tie gang might more than double daily tie insertion, to a thousand. We were gratified when our first report of one thousand ties a day drifted in. Then an amazing thing happened. Gangs began exceeding the one thousand total and competing with one another to do more. This competition was picked up by our engineering officers and supervisors and publicized in our company newspaper. I might add that in a discussion with the BPO of the Frisco, it prompted him to establish the same thing and the competition was established between the MoPac and the Frisco. Eventually, we had crews inserting more than three thousand ties in a single day.

The men were also acknowledged in numerous ways. One gang even became the subject of a video tape depicting their daily labor set to a disco beat. It was shown at a special dinner in their honor. For their wives to see them at work meant far more to those men than a few extra dollars in their pay checks. It also probably had some of the brotherhood chairmen muttering about speedups, and that raises a third point.

People can have a dual loyalty, both to their union or brotherhood, and to their company. All of us have dual loyalties, whether it be to church and country, or the family and job. All of us manage to balance them most of the time.

It is not surprising how many of our scheduled employees wear gear emblazoned with the railroad logo at the same time they wear their union buttons.

I am reminded of a man in our Company named Orville Belcher — not a railroad man, but a former driver for the Missouri Pacific Truck Line. According to his supervisor, Mr. Belcher was the safest driver, the most courteous driver, the most cooperative, and an excellent driver salesman. He was always attired in a neatly pressed, clean uniform. Not only that, but he encouraged his fellow drivers to wear the uniforms, which were optional, and even took the soiled uniforms to the cleaners for his co-workers. He was a company man in the best sense of the term.

Mr. Belcher also happened to be the local teamster's union steward. Mr. Belcher is now retired but others have taken his place.

Fourth, as emphasized in the supervisor employee survey mentioned earlier, the employees want to feel "in" on things, or, in other words, informed about the important things going on around the company. Our old surveys show clearly that the average employee is concerned about the same things as you and I. The company's economic performance, its competitive position, capital investment plans, and the contributions. Those items make job satisfaction.

Those surveys, as well as numerous surveys made by other companies, also indicate that the supervisor is the medium the employee considers to be the most creditable company information source, and the medium from whom he desires more information.

It is human nature to feel more "in" on things and therefore feel more important as a person, when it is the boss, not the company newspaper, who is providing the information.

Fifth, we must be willing to listen to the worker's ideas and allow him, where possible, to have his ideas tried on the work process. People seem to take pride and work harder on a project in which they have a personal investment.

Just a few months ago we told our shop employees at North Little Rock of plans to construct a new, modern heavy diesel repair shop. Our mechanical officers had on hand a detailed model of the workshop area and, as part of the presentation, asked the employees to study it and determine if it was practical from their standpoint. The employees found the design to be excellent. But, they also made worthwhile suggestions, which will be incorporated into the final design of the shop.

This is not at all dissimilar from the "work circle" concept common in Japanese industry. I am hoping it will improve production at our shop in the same way it has improved production in a Japanese automobile assembly plant.

Item six. People respond to sincere enthusiasm and interest of the manager. If you let people know that you are indeed both serious and enthusiastic about a project, they usually will respond in kind. Again I will use an example from MoPac.

For years we were "shut out" in the Harriman Safety Competition, despite devoting considerable effort to our employee safety programs. Then we began to place more focus for program responsibility on individual employees. At the same time, it was emphasized to our supervisors that safety was a top priority of senior management. Safety teams were organized among all work groups. A massive poster campaign was launched, and employee-produced safety periodicals began to appear. Money was available for awards and dinners to honor top safety groups.

A spirit of enthusiastic competition was born. As a result, MoPac won the Bronze Medal in 1977-78-79, and the Silver Medal last year. This year we feel that we have an excellent chance to capture the Gold as our employees know we take safety seriously and are willing to enthusiastically acknowledge their contribution.

Finally, in employee motivation, it is imperative that the manager maintain a high level of personal integrity in his dealings with the work force. Each manager must manage in a style appropriate to his personality. Some get results through non-coercive, easy-going approach. Others are tough, but also foster satisfaction among the men who work for them. Integrity seems to be the common thread in either side of management. To me, integrity means "not lying to the men," but giving them the facts, "not playing favorites" nor setting one worker against another, "treating everyone fairly," not degrading your own supervisor nor the Company in front of the men, and, finally, behaving day-to-day in a consistent manner.

Those are some of the elements to consider in analyzing your own management style and your performance as a manager of people. Harder work and superior quality of work are not the sole solutions to the problem of productivity, but they can make a significant contribution.

Examine Your Own Job

My final challenge to you in the quest for improved productivity is to examine each element of your own job as if you were an outside expert seeing it for the first time. Do not forget you are the expert in your areas of endeavor. Each element of your operation should be reduced to basics and questioned. Why do we do it this way? Might it be done differently each year, or better? Is it organized for maximum efficiency? What alternatives might be available? Which of these alternatives would be most effective in terms of quality and quantity of production, time and money?

Allow your imagination to soar, to entertain what at first glance might seem very impractical. Every job contains within it a hidden challenge. That challenge is this: how can it be done better?

Could anything possess less challenge than sweeping a floor? Murray Spangler, a janitor in a department store in Canton, Ohio, a number of years ago, did not think so. Many people would quit a job like this. Instead, Spangler set out to find a better way to clean floors. The way to eliminate the broom. His quest for finding a better way led to a crude, but workable, vacuum cleaner, which he induced an old friend in the leather business to finance. The friend's name was Hoover.

I can recall one of our maintenance officers who had less than average production records. His defense was that the heavy traffic over his territory did not provide sufficient windows of time to carry out the work. That sounds familiar, does it not? Although true, no practical way could be found to reschedule the traffic. Further analysis showed traffic to be light during the night hours, however. Sufficient lighting was strategically placed, and the crews worked nights. The increase in production more than offset the additional cost and a vital segment of the railroad was brought into first-class condition within a very brief period of time.

Room for creativity in the work of the engineer and maintenance forces will be found, if we only look for the opportunities. We are bound, of course, by company policies and by the physical limitations of what can be done with the materials at hand.

Football, too, is played within tightly prescribed rules, yet, as we all know, literally thousands of options are open to both the offense and the defense to utilize in attaining goals.

Tom DeButts, former Vice President of Labor for the Burlington Northern, proposed this several years ago. The individual upon whom the institution makes the greatest demands is the individual who is more comfortable with the institution. The institution upon whom the individual makes the greatest demands is the institution with which the individual is least comfortable. I wish you would think about that.

I believe that the man or woman who faces and overcomes real challenge develops a sense of pride. Pride is the foundation upon which rests personal productivity.

It is our responsibility to create the proper atmosphere on the job site which will make possible the existence of a productive work force. Good supervision is the art of getting average people to do superior work. We as individuals bear the same responsibility.

Finally, two ways prove the worth

of each of us. We can shoot first and then draw a bullseye around the hole, or, we can draw a better bullseye, and then shoot. Thank you. (Applause)

President Chambers: Thank you, Mr. Gessner, for taking time from your busy schedule to present to us an informative and most timely inspiring Keynote Address. We invite you to stay with us for the remainder of this morning's joint session. However, if your schedule demands it, please feel free to leave at any time. Thank you, Mr. Gessner.

The next speaker on this morning's program will be introduced to you by Mr. Hyma. Mr. Hyma is a Vice President of our Association and Chairman of the Special Subjects Committee.

Mr. Hyma: Thank you, President Chambers.

Before introducing our next speaker, I might comment to Mr. Gessner that those of us on the Santa Fe might take issue with their goal of winning the Gold Medal of the Harriman Award.

Our next speaker is Mr. John Donahue of the Long Island Railroad. Mr. Donahue was graduated from the Polytechnic Institute of Brooklyn in 1960 with a Bachelor of Science degree in Civil Engineering. He is now licensed as Professional Engineer in the State of New York.

He began his career in the Construction Division of the New York City Transit Authority, working first as a steel inspector, surveyor and a Field Office Engineer.

Mr. Donahue joined the Long Island Railroad Company in 1967 as a Structural Designer, and then as Office Engineer, responsible for track layout, sidetrack design, agreements and engineering contracts.

In 1971, he was promoted to Manager, Civil Engineering and Design, in charge of the design staff for buildings, platforms, bridges and viaducts. In this position he reviewed and contributed to the design of grade separations, using pre-stressed concrete beams, and the design of continuously reinforced concrete slab track.

Since February of 1980, Mr. Donahue has been assistant Chief Engineer of Design and Construction.

His presentation today will cover Continuous Reinforced Concrete Slab Track on the Long Island Railroad. It is my pleasure to present Mr. John Donahue. (Applause)

Continuous Reinforced Slab Track On The Long Island R.R.

By J. R. DONAHUE

Assistant Chief Engineer, Design & Construction, Long Island, Jamaica, N.Y.

J. R. Donahue

Thank you, Mr. Hyma, ladies and gentlemen:

It is a pleasure to make a presentation in Chicago, away from Long Island, because usually when we present something in Long Island, it finishes up with all the irate commuters raising their hands and wanting to know why they were late last night and why their dinner was cold, and a woman standing up, complaining that the whistles are too loud. So, at least I will not have those complaints today. Thank you.

I would like to go over, first, a little information about the Long Island Railroad and how we changed to planned slab track and how we came to this design, and then, finally, how we built it.

The Long Island Railroad operates into the busiest terminal in the United States, which is Penn Station. It operates through the busiest railroad junction to make it. During rush hours, trains operate on the average of every thirty seconds.

It has the busiest suburban station in the country, Hicksville, which handles 5,800 passengers during a morning rush hour period. More than 280,000 passengers use the Long Island Railroad on an average week day.

The Railroad schedules 870 trains on week days, of which 713 are passenger-carrying trains and the remainder are equipment trains. Some 452 trains are scheduled for Saturday and Sunday operations.

The maximum allowable speed is 80 miles an hour for electric trains — 65 miles an hour for diesel passenger trains — and 45 for freight trains.

The nine branches add up to about 700 track miles. The Montauk branch is the longest branch, with 117 miles.

Train density increases as you travel west on this branch, the Montauk Branch. At its western end it carries 345 trains per day, with a passenger load of 61,000 commuters per day.

Due to the heavy train traffic on the Montauk Branch, the maintenance of the branch is very costly. Maintenance is done between trains during mid-day. Heavy maintenance, such as tie or rail renewal, is done during the day, with all traffic running on the adjacent track.

The heavy emphasis by the public and news media on "on-time" performance limits the amount of single track that can be used for maintenance.

Time Ripe For Slab Track

With this in mind and a new grade crossing elimination project in design, the time was ripe for slab track. The Railroad had used direct fixation on two previous grade crossing eliminations. These projects included over eight miles of viaduct structures, consisting of 72-foot long spans of pre-stressed concrete I-beams, with a poured-in-place slab, 18 feet wide on top.

Small concrete pads were poured every 30 inches, and the top surface carefully set to line and grade.

Direct fixation fasteners made by the Landis Fastener Company were then set on the pads to hold the running rail.

This system had been well developed and was considered successful. This third rail insulator on a pad sets the line in grade.

Our Balmoral viaduct, is approximately 5 years old now.

In addition, our Chief Engineer, John Woodward, at that time, had visited slab track installation in England and Germany. The British rail experience gave us a good basis for design. The advantages of decreased maintenance and less interference with train schedules and the long life of concrete, along with the improved stability of line and grades for high-speed operation, outweighed the additional cost of slab track over wood ties and ballast.

The New York State DOT was willing to finance the slab track based on our recommendations and its use as a test section for future installations. After much discussion and design review, it was decided to go ahead with the concrete slab on the embankment section.

Embankment Test Section

The Landis Fasteners were lying directly on the concrete slab, without the pad that was set to line and grade.

It was decided to pour the top of the slab to a tolerance to plus zero and minus a quarter inch. Many said it could not be done but the contractors proved it was possible. The contractor was permitted to use polyethylene pads under the Landis Fasteners where shims were necessary.

We were confident we could build an embankment that would not settle based on tests made during construction of the previous grade elimination projects. Plate bearing tests were made by the State Soils Department which indicated a "K" value or modulus of sub-grade reaction of 450 pci could be obtained with normal procedures.

A 6-inch fixed stabilized bituminous sub-base would distribute the load from the concrete slab and serve as a working base or setting for the concrete slab.

The final design evolved to consist of an embankment roughly 17-feet high. This was built in 12-inch lifts compacted with 2-ton rollers to 100% of maximum density as measured by the standard Proctor method.

The 6-inch thick 14½-foot wide stabilized bituminous sub-base was laid on a sub-grade and a concrete slab 12-inches thick under the rails and 10½-feet wide was then set on the sub-base.

The top surface was level under the rail fasteners and pitched at an 8-inch per foot upwards to the center and downwards to the outside. This was done to insure drainage to the side.

Concrete strength of 4,000 psi was called for. Design criteria was an E-30 loading at 100 miles an hour and an E-72 loading at 65 miles an hour.

The longitudinal reinforcing steel consists of grade 60 bars in two layers. The top reinforcement consists of 18 No. 5 bars; the bottom reinforcement, 18 No. 6 bars. This results in a steel percentage of .9%. Transverse bars were No. 4's, 24 inches on center.

The anchor bolts for the Landis fastener would be set in epoxy coated inserts, which were then set in epoxy filled holes, cored in the concrete.

The 119-pound RE rail was used as the running rail and it was held in place with Pandrol clips.

The third rail bracket is held down by two bolts also set into epoxy filled cored holes. The epoxy provides electrical insulation as well as the high strength anchorage in the concrete.

Design Developed by Long Island R.R. Staff and New York DOT

This design was developed by the Long Island Railroad Design staff and the New York State Department of Transportation Soils Department.

Once the cross section was developed, we had to address the other details of continuously reinforced concrete or CRC slabs. Like continuously welded rail, a CRC slab is restricted from expanding in the center of its length but wants to expand at the ends.

With CWR, we box anchored it 100 feet on either side of the joints, but it is a bit harder to hold back expanding concrete.

Both ends of the slab terminate at a bridge abutment. In order to prevent expansion into the back walls, the CRC slab was ended 35 feet from the abutment. The end rests on a sleeper slab 10-feet long.

The bridge approach slab varying in thickness from 18 inches to 12 inches extends from the abutment to the sleeper slab.

Two relief slabs rest on a sleeper and approach slabs. A four inch expansion joint is between the CRC slab and the first relief slab, and one inch joints between the relief slab and the bridge slab.

All joints are protected with Fel-span expansion joint material to keep ballast or soil from filling the joint.

A seasonal expansion and contraction of one inch is expected and a long-term expansion of two inches is possible.

The CRC is carried over two intermediate through-girder bridges without any joints. In order to permit the bridge to expand and contract under the CRC slab, a bond breaker consisting of two sheets of polyethylene between two layers of bituminous material was laid on the bridge deck before the CRC slab pouring.

As I said, the details of the CRC were developed jointly by the Long Island Railroad and the New York State DOT. The rest of the project was designed by the consulting firm of Charles W. Sells, Inc., from Pleasantville, New York.

Going to the total project, the total grade elimination project was 2.3 miles long and eliminates three grade crossings. The project is part of the New York State Grade Crossing Elimination Program and was paid for by New York State DOT funds.

The three street crossings and a new access road to a shopping mall were replaced with plate steel through-girder bridges.

Unqua Creek was spanned with a concrete bridge using box beams. A viaduct 1,400 feet long provides parking and access to the 1,050 Long Island platform. A new station building below the viaduct and a shelter at platform level were provided.

The tracks extend from the Massapequa Station which was lengthened as part of the project, and continues east with 35-foot 2-inch track centers through the slab on embankment area to the new Massapequa Park Station platform, and continues east where two slight curves provide 14-foot track centers to pass over the existing Sunrise Highway Bridge.

The track alignment was designed for 100-mile per hour speeds.

Temporary Tracks Built

The first step in the construction procedure was to build two temporary tracks. The tracks curved under Sunrise Highway and down to the South, to the existing tracks. The temporary track, was built curving down to the south to give us room to build the final portion.

A temporary platform was built just south of the existing tracks, and in this case south of the new construction. We were very tight to the Sunrise Highway, which is a very heavily traveled local road.

The far platform has a cover over it to protect the passengers from any construction debris or mistakes while they are waiting for a train.

As I mentioned, Sunrise Highway created quite a traffic problem, due to turning traffic and the possibility of trapping cars on the tracks when a train was approaching.

During the year, prior to when we started construction, three people were killed at the Unqua Road crossing in train/automobile accidents. That Unqua Road was closed. We just could not work out a way not to trap cars at that crossing.

The Viaduct Structure

The viaduct structure consists of cast-in-place concrete piers, which support two 5-foot by 5-foot box beams.

The box beams are pre-stressed concrete beams 85-feet long, prefabricated in New Jersey and shipped by truck to the site. The box beams sit on elastomeric bearings. The box beams have loops extending from the top to provide composite action with the poured-in-place slab on top.

Side forms were built and reinforcing bars laid in place. Templates holding epoxy coated inserts for the track fastener bolts were installed.

The anchor bolts are actually threaded studs, screwed into coil fasteners with four legs sticking out. It is carefully set so that it does not touch reinforcing, and no electrical contact will result. The reason we use studs is that we can back off the studs out of the concrete enough to remove the Landis fasteners out from under the rail, without lifting up the running rail.

While the box beams were being fabricated, the contractors, a joint venture of Henderson Brothers and Horne Construction Company, built the embankment and the slab tracks. Due to the close proximity of Sunrise Highway and the temporary tracks, a full embankment could not be built. Steel sheeting confined the embankment and provided room for the temporary track.

On the north side, the embankment was confined with a two tiered retaining wall. Shrubs were planted between the tiers and the wall was faced with cut stone which was a very expensive piece of construction for the local village people.

The top of the embankment was fine-graded and a bituminous sub-base laid with conventional paving equipment. Side forms for the concrete slab were carefully set to line and grade. Where the sub-base was not to grade, it was cut away or patched to bring it to grade. These side forms determine the grade of the top surface of the CRC slabs. The sub-base also served as a working and traveling surface.

Reinforcing bars were set on chairs. They were carefully set to avoid the areas where cores were to be taken.

Concrete was delivered by transit truck and dumped into the forms by bucket. Manually operated spud vibrators were used to spread and consolidate the concrete. An initial screed was used to bring the concrete to a finish slightly higher than the final. The final shape was obtained with a second screed with a vibrator. Masons on a moving scaffold touched up the surface and applied a broom finish for a uniform non-slip surface. A white pigmented curing compound was sprayed on the slab.

Production averaged three hundred feet per day. A construction joint was formed at the end of each day's pour. Transverse reinforcing was doubled and longitudinal reinforcing increased by a third, ten feet on either side of the construction joint.

The ends of the slabs were poured as detailed previously to accommodate expansion. The sleeper slab and approach slab were formed with a bituminous filled gap between them.

After the reinforcing steel was installed, along with the structural "T," the concrete was poured. This completed the sub-base details at the abutments.

Once the CRC slab was poured, the Fel-span joint was anchored with bolts over the expansion joints.

The west end of the CRC slab started at Unqua Creek bridge.

The ballasted areas we used for the

track cuts, where we shifted the track. In one day, on a Saturday, we shifted both tracks, from the temporaries onto the final, and that started operation on that track.

Unqua Creek Bridge

Unqua Creek Bridge was made up of five-foot by five-foot box beams and cast-in-place top slab similar to the viaduct structure. The slab continues for 1,701 feet east of the viaduct structure, where it ended. The slab picks up again east of the viaduct and is continuous for 4,258 feet to the east crossing over the Broadway and Unqua Roads.

Unqua Road, as I said before, had to be closed in order to prevent accidents. Only a very little distance was between Sunrise Highway and the bridge structure. It is just open for pedestrians with a pedestrian crossing there.

The continuously reinforced concrete slabs are terminated west of the abutment for the Sunrise Mall access road.

To the right is a very large shopping center and they paid for us to include an access bridge to their parking lot. The slab was ended at that bridge and from that point east we built ballasted track.

The tracks continue east of this bridge as conventional wood tie in ballast track. This ballasted area was the scene of the track cuts and shifts on Saturday, December 13, 1980, when the new tracks and station were put in service.

A few days after the concrete slab was poured, the location for the fastener anchor bolts was laid out and four-inch diameter holes were cored into the slab. Positioning and depth of the holes was carefully monitored to avoid cutting the reinforcing bars. After the holes were made and cleaned out, epoxy coated loop inserts were placed in the holes hung from a jig to hold them in position. The holes were then filled with epoxy-sand compound and left to set.

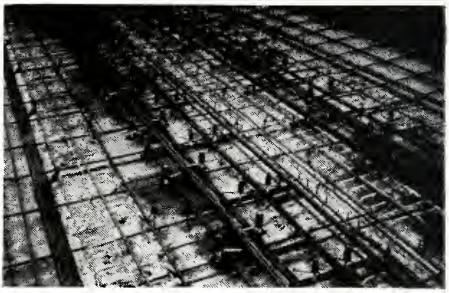
One out of every five hundred inserts were proof loaded to a 14,000-pound pull-out load.

The surface around each insert and stud was carefully leveled and smoothed and then a Landis fastener was placed over each pair of studs. When the fasteners were all installed, continuously welded running rail was pulled into place and anchored down with Pandrol clips driven into a casting made to fit the slots for the Landis pad.

Once the running rail was set to line and grade, a template located the anchor bolts for the third rail brackets. Holes were cored and the anchor bolts were set in epoxy-sand compound. Third rail brackets were bolted down then insulators, rail and boards were installed. This completed the track structure.

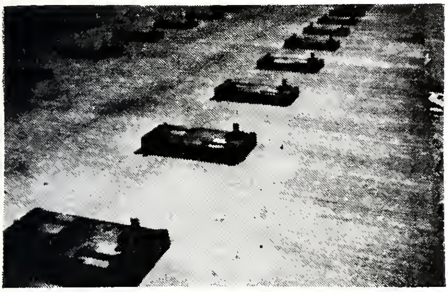
Testing of the Slab Track

Test trains were run for two weeks to set fasteners and develop any problems. No problems arose and the slab track

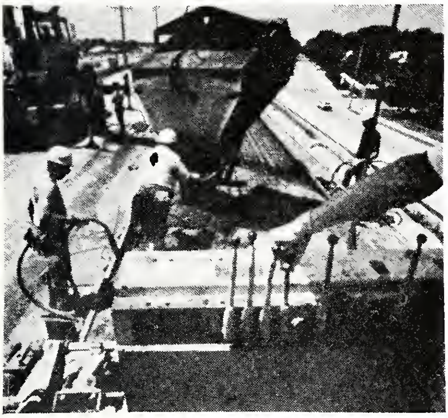


Supporting the CRC slabs are two layers of steel, with #6 bars in the bottom section, #5 bars in the top and transverse #4 bars. The 24-inch laps total 0.9 percent steel longitudinally.

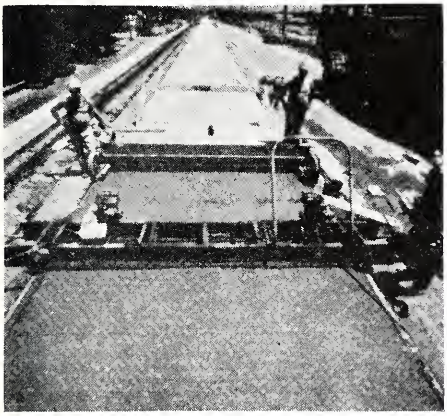
Sleeper slabs and jointed approach slabs with neoprene expansion joints were installed to accommodate movement of the CRC slabs. Slab continued over the decks of two short spans.



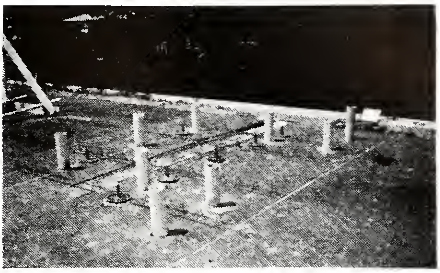
Laminations of neoprene and steel plates compose the 7 x 15-inch Landis fastener pads bolted to the slabs.



Jaeger model finisher lays ready-mixed 4000 psi concrete over the supporting steel "spiders." The two parallel concrete slabs are each 10.5-feet wide and 12-inches thick.

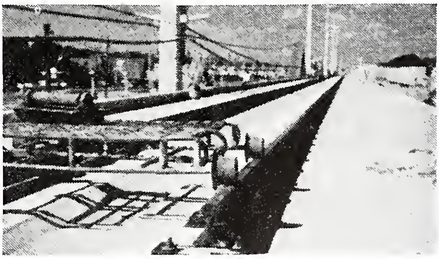


Special screed obtains the desired profile, with progress averaging 800-feet per day. Concrete was cured with a white pigmented compound sprayed on the surface.



Epoxy-coated bolt inserts for the track fastener were held clear of the core hole bottom and sides by a template. Holes, installed at 2½-foot centers, were hand filled with grout.

Grout mixture was formulated to obtain a minimum pullout strength of 14 kips. Random incremental proof loadings to this limit revealed no sign of stress in the concrete slab pavement.



Landis pads permit lateral adjustment while Pandrol clips secure rail to the pads. Running rail is aligned, third rail placed.

Included in the project was a 1500-foot long concrete viaduct with 5 x 5-foot prestressed concrete box beams.

has been trouble-free since then.

Since the CRC slab was new to this country and its design was based on a theory developed for CRC highway slabs, it was decided to hire a testing agency to develop and implement a testing program. The Long Island Railroad contracted with the Construction Technology Laboratories of the Portland Cement Association to instrument and monitor two test sections in the middle of the longer section of slab track. The two test sections are identical and include pressure cells in the subgrade and sub-base and settlement markers in the sub-base, sub-grade and slab. Strain gauges were installed on longitudinal and transverse re-bars and in the concrete along with the thermocouples to measure temperature distribution.

Displacement transducers were also installed to measure deflections.

A specially designed instrumented fastener base plates were installed to measure forces transmitted from the rails to the fastener and slab.

All the data was transmitted to a computerized data acquisition system housed in a van. The data were collected in October, 1980, during a two-week test train period prior to opening the track to revenue service. Six months later, data were again taken during revenue service. They were actually taking tests yesterday and today, the third set of tests.

The test trains consisted of six-car multiple-unit electric train, known as M-1's and a second train made up of Gp-38 diesel locomotive pulling five passenger cars and a converted PC-7 push-pull power unit. The trains were run at various speeds of 10, 30, 60 and 80 miles an hour. Data was collected at static loading and under varying speeds.

The M-1 test train in October had flat wheels due to braking on leaf strewn tracks. The data indicated that the flat wheels increased passenger load by seventy-nine percent above the static load. The data indicated operating speed had little effect on fastener loads. Slab deflections under diesel locomotives and electric cars averaged .011 and .008 inches respectively.

Concrete strains were generally low. However, electric cars produced the largest concrete stresses, probably due to the flat wheels.

The greatest stress occurred on the slab surface and was approximately 370 psi.

The steel strains again were generally low. The largest calculated stress was 1,540 psi, which is well below the 60,000 allowable. We do expect higher stresses due to temperature changes than we would get from deflections under the operating trains.

Sub-base and sub-grade pressures were generally low. The maximum subgrade pressure was 2.4 psi.

The last test section is taking place right now and we will get a final report, which will summarize all the results.

The Railroad is now applying for a grant to continue testing for the next two years. It looks very positive they are interested in financing this to gather more information on the long term effects of the CRC slab.

Conclusion

In conclusion, the Long Island Railroad along with New York State DOT, has constructed and is now operating on 2.26 track miles of continuously reinforced concrete slab track. After ten months of service, the slab is performing as expected. An in-depth testing program has shown that the working stresses are lower than design values and indicate a long life. Further testing will be done to continue to monitor the performance of this one of a kind slab track.

To show our confidence, the Railroad is now in the process of designing CRC slab track to be used in two yards, one, the West Side Yard, which is going to be built just west of the Penn Station, to hold three hundred passenger cars, thirty tracks wide, and all those thirty tracks are in the area where the trains will be maintained and the toilets emptied. The men working under them will be on concrete.

We are also planning to use concrete slab in the Richmond Hill Yard rehabilitation, where we are going to be fueling these under-car power plants. Under the diesel cars for environmental reasons we are using concrete slabs to collect any oil spillage or fuel spillage.

We also have a capital improvement program where we are going to be double-track roughly thirty-five miles of track and we are considering using concrete reinforced slab track for that double-track.

That is all we have on the slab. Anybody have any questions? Any comments?

Delegate: When the contractor installed this, did not he use any shims under the fasteners?

Mr. Donahue: We allowed them to use up to 3/8ths inch in polythylene pads in one-inch increments. He had a zero tolerance upwards and then he had 3/8ths inch to play from that, and he was able to do it. Anybody else? Thank you very much. (Applause)

President Chambers: Thank you, gentlemen, Mr. Hyma and Mr. Donahue, for your time and effort on behalf of this organization. It was very informative, timely and interesting. I cannot thank you enough. All the people who spend their time and effort in making these reports are really an asset to this organization.

The next speaker will be introduced to you by Mr. J. N. Michel. He is a Director of the Association and Chairman of the Advertising Committee and serves on the Publication Committee. Mr. Michel.

Mr. Michel: Thank you, Mr. President.

During the 1970's these Association meetings offered several presentations on environmental presentations and the rail industry's efforts to deal with these rules. While we must all practice good citizenship and protect the environment, the 1980's are seeing a new scene—deregulation.

Also, as we enter the '80's, advancements in science and medicine are questioning many of the practices that we have taken for granted for years as being safe.

We are most fortunate to have with us today Mr. Peter Conlon of the AAR Research & Test Department, who will share some of his observations on "Environmental Quality and the Rail Industry."

Mr. Conlon is a native of Massachusetts, having received his Bachelor's degree from Antioch College in 1972.

After graduation, he joined one of the leading environmental consulting firms, participating in numerous air, noise, thermal and water pollution studies.

In 1978, he joined the AAR Research & Test Department, concentrating on railroad noise, diesel emissions, hazardous material and toxic substance problems.

Presently, he is Manager of the Environmental Studies Division. An active member of over half-dozen professional organizations, Mr. Conlon provides an authoritative voice for the rail industry in the environmental field.

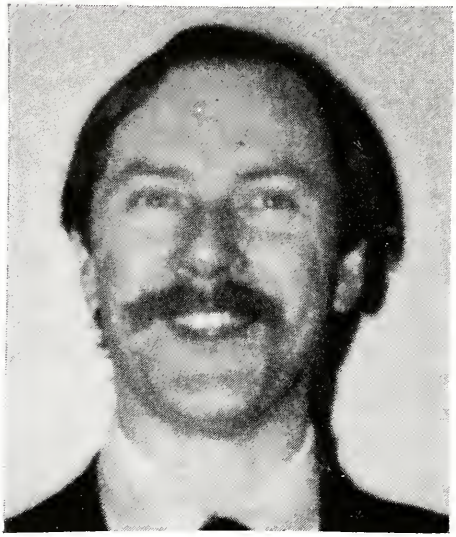
At this time it is my pleasure to introduce Mr. Peter Conlon. (Applause)

* * *

Environment Quality and the Railroad Industry

By PETER CONLON

Association of American Railroads, Washington, D.C.



Peter Conlon

Thank you, Mr. Michel. Good morning, ladies and gentlemen:

It is my pleasure to have this opportunity to discuss with you two areas of great concern to all of us, our environment and our railroads.

Those of you who have been railroading for many years will remember the days when a train ride left you covered with cinders, and, when the city fathers dispatched smoke watchers over to the station to check on the fireman's ability to control his charge.

After that comment, this week I rode behind the Chessie System's Special and I think I am still picking cinders out of my hair. It was very much like that.

The ash dumping pits and roundhouse area were always so covered with soot it took a small army to keep things clean. We have a wonderful collection of old photographs in the AAR which I used to great advantage in developing this presentation.

Those were the days! Those images came to mind when someone mentioned railroads. What they did not imagine were some of the more insidious forms of pollution, such as chemicals spilled in a derailment or fuel oil spilled onto the ground for years, creeping towards the ground water. Yes, railroading used to be a dirty business below the surface as well as above it.

Times Have Changed

Times have changed, though, and some of the trademarks of old-time railroading have all but vanished. Today I would like to cover some of the progress that has been made over the past few years in the environmental area, changes so dramatic that many people are surprised to learn how modern railroads really are. Of course, I do not need to tell you all that.

Since 1972, environmental concern in the railroad industry has increased tremendously, coinciding with the passage of the National Environmental Policy Act. That law set up the requirements of the Environmental Impact Statement, something I am sure most of you have all faced at one time or another.

The Association of American Railroads and our member railroad companies have been actively involved in legislative and regulatory issues and research relating to environmental qualities since that time.

The Research & Test Department took over the responsibility of evaluating the effects of proposed laws and regulations on the railroad industry. Ad hoc committees of technical railroad personnel have been formed to address key areas, such as diesel smoke emission, noise and human waste disposal. These committees coordinated efforts with the Law Department to develop highly technical comments for EPA and Congressional staff members. Our legislative department provides the means for carrying messages to the right places ensuring the best chances for favorable action.

Most recently, the Operating Transportation General Committee formed a standing committee of railroad environmental experts to advise them on the impact of environmental rules on railroad operations. The first Committee meeting, incidentally, was held just the other day and I think we are off to a rather good start. Thirteen individuals represent that Committee at this time and as we reflect the membership of the OT General Committee soon eighteen people will be sitting on this Committee.

Environmental Laws

I would like to talk briefly about the environmental laws and their effects on the railroads, beginning with water.

Clean Water Act

The Clean Water Act is responsible for controlling the discharge of wastes into the nation's waterways. It was enacted in 1965 and amended in 1972 and 1977 to encompass concerns of municipal and industrial waste water treatment. Railroads are affected by this law in several ways. For example, all shop wastes must be collected in a sewer system and transported to a treatment plant for treatment to remove oil, grease and solids prior to discharge to a stream or into a city sewer system.

Another good example is that railroads no longer use chromate in the cooling systems of locomotives. Almost everyone now is using a borate substance, which is bio-degradable and whenever some of the cooling water has to be dumped onto the ground you do not have to worry about water pollution any longer.

Spillage from sanding and fueling facilities and wash racks is also captured in track pans and piped to the waste water treatment facility. The facility can be as simple as a gravity oil/water separator or as complicated as a physical/chemical treatment system, designed for complete waste reduction and treatment.

A by-product of the shop waste water system is resource recovery. Oil can be removed from the waste water and refined for reuse.

I have heard recently that the recovery people are paying as high as eighty cents a gallon for this product.

Other requirements of the Clean Water Act include the Spill Prevention and Control Contingency Plan. This plan must be posted at any facility having oil storage tanks and equipment to fight the spills and must be readily available in case of spill emergency. Both the Coast Guard and EPA are involved in monitoring these and other Clean Water Act requirements.

Air Pollution

Air pollution, as I mentioned earlier, is probably the most obvious form of pollution and we have been faced with it for the past one hundred seventy-five years in this business. Steam engines, of course, cannot be compared with the modern diesel, at least, when it is operating properly.

Some smoke is unavoidable and continues to be a problem. Communities are frequently complaining to railroad companies about the smoke. At one time the AAR developed smoke-measuring guidelines and a proposed model ordinance that reflects the realities of engine operation. A fair number of cities and states have adopted it as their rule, easing the burden on locomotive maintenance people.

Particulate matter, or unburned soot, is currently a high research priority at the EPA. With the increased use of diesel engines in automobiles, concern is raised regarding possible health problems. A study of deceased railroad workers is being conducted by the Harvard School of Public Health to determine if any relationship exists between occupational exposure to diesel and cause of death.

The AAR is also conducting a series of diesel exhaust emission tests. A mobile laboratory has been constructed and is designed to measure hydrocarbons, carbon monoxide, carbon dioxide, oxygen, nitrogen oxide, opacity of the smoke, sulphur dioxide and particulate matter.

The operating conditions of each engine are being tested, monitored and recorded. We hope to determine how much improvement in combustion efficiency has occurred in the past ten years, as well as to establish the range of emissions one would expect over normal engine life.

Another major change resulting from air pollution regulations is that open burning is no longer permitted. Formerly, retired freight cars were burned out prior to being cut up for scrap. Also, burning old cross ties along the right-of-way has been outlawed in most places. Efforts to recycle this potential fuel source have been generally unsuccessful, due to labor and transportation costs involved in moving the wood. But, as fuel costs rise, this may be more economical in certain cases. Old ties have also been successfully recycled into new ties by a chipping operation and regluing them back into a cross tie piece. We have been testing those out at the Fast Track in Pueblo for some time now.

Noise Pollution

My favorite subject — noise. The railroads have been very active in the noise pollution field for several years. As population grew in this country, more and more people found themselves within earshot of a railroad track. Despite the fact the railroad was there first, in most cases, the citizenry was often successful in forcing the railroads to stop blowing horns at crossings and to pass some locations at a slower speed to reduce noise and vibration. Sometimes even classification yards have adjusted schedules to reduce noise.

Rather than continue to be faced with a myriad of noise ordinances, the AAR Board of Directors voted to ask Congress for federal pre-emption over state and local noise regulations. Section Seventeen of the Noise Control Act of 1972 gave us just that. EPA was directed to issue noise regulations for equipment and facilities of interstate rail carriers which reflect the degree of noise reduction achievable through the application of best available technology, taking into account the cost of compliance. The Department of Transportation was assigned the task of developing the enforcement regulations.

Final standards for locomotives and moving rail cars were issued in 1976 and standards for retarder operation, load cell test stands, car coupling noise and switch engines were published last year.

Noise abatement techniques, such as noise barriers, directly adjacent to a retarder, have proven to be somewhat effective, while other attempts to reduce noise, such as a giant locomotive muffler, have not been readily adaptable to normal every-day use. I would like to point out, though, that, of course, that was a research project and not an attempt to design a muffler to fit into a locomotive.

I was at EMC yesterday and I did get a chance to look at some of the new mufflers that are put on locomotives built since the beginning of the year and they are probably about one-tenth the size the giant test muffler. They fit quite nicely on top the turbocharger exhaust vent, within the locomotive car body. It is interesting, too, as they showed me yesterday, that the back pressure in the exhaust system has been reduced tremendously with these mufflers. Some increase in the fuel economy has been observable, so, I think, despite the noise about noise regulation, some benefit has resulted.

President Reagan's budget slashing, though, has jeopardized our pre-emption and Congress is right now considering repealing most of the noise control act. If Section 17 is repealed, all federal standards will be eliminated and states will no longer be bound by the pre-emption provisions that prevent them from enforcing ordinances stricter than the EPA standards.

Mr. Dempsey recently testified before the Senate Committee on Environment and Public Works concerning the need to maintain federal pre-emption and the draft bill that was reported out did contain a modified version of Section Seventeen. However, we do not know what the final outcome will be. We expect to see something in October and I am hopeful we can maintain some type of uniformity for noise standards for the railroad industry.

Right-of-Way Management

Right-of-way management is also affected by environmental laws. The Federal Insecticide, Fungicide and Rodenticide Act, also known as FIFR, regulates the use of such commonly used chemicals as 2,4,5-T, creosote and pentachlorophenol. A most effective herbicide, 2,4,5-T was banned by EPA in 1980 because of the link between aerial spraying of forests in Oregon and miscarriages in human beings.

Since that time, a variety of other herbicides have been used in right-of-way weed and brush control. AAR is currently planning to survey the industry this year to determine what those chemicals are and how effective each chemical in use actually is now. We have come to believe that preparing ourselves with adequate information on these pesticides before a regulatory review arises, will save considerable time and expense for the data collection in the long run.

Occasionally, each major class of chemicals is reviewed by EPA to determine if they pose a danger to health and the environment.

As most of you know, the wood preservatives recently underwent such a review. AAR worked with the American Wood Preservers Institute to evaluate the scientific evidence of penta and creosote. We provided EPA with environmental impact information and health data on the railroad industry, which showed little or no adverse effect resulting from normal use.

Economical data were also provided showing that if the wood preservatives were banned, the cost to the railroad industry might exceed three and nine-tenths million dollars in capital replacement costs, if concrete cross ties replaced wood ones.

While the final word from EPA is yet to come, all indications are the creosote and penta will be re-registered with relatively simple restrictions. In their position document issued this spring, EPA described restrictions such as requiring the use of gloves and other protective clothing and respirators during creosote applications at treatment plants.

Also discussed was the requirements for each crew applying creosote to be directly supervised by a certified applicator and that all personnel wear coveralls and other protective clothing. Based on comments from our members, we objected to the requirements as they applied to track workers as being unnecessary, costly, and, in the case of protective coveralls, actually dangerous in hot weather because of the danger of heat stroke.

Hazardous Waste

The most recent and most comprehensive regulations to be issued yet are the hazardous waste rules promulgated by EPA under authority of the Resource Conservation and Recovery Act, known to us in the business as RCRA.

President Reagan singled these rules out as the most complex regulations in the history of the federal government, and with good reason. These rules attempt to track all hazardous wastes above a certain minimum quantity from point of generation to ultimate disposal. A waste product is hazardous if it is specifically listed by EPA or if it meets certain criteria of corrosiveness, reactivity, ignitability or toxicity.

If you produce a hazardous waste in quantities exceeding one hundred kilograms per month, you must register with EPA as a waste generator. Many railroads have found themselves to be generators of hazardous waste, particularly in the repair shops.

Old crossties, by the way, are not considered by EPA to be a hazardous waste, although I understand some states take issue with that, and, of course, the state can over-ride the EPA regulations with more strict regulations.

Of course, railroads transport hazardous waste. You must also be registered with EPA as transporters and have a number assigned to each company. In the process of transportation, each waste shipment must be accompanied with its own manifest detailing the nature of the material as well as its destination. The railroads petitioned for, and, were granted an exemption from this requirement, since all pertinent data are already contained in the shipping papers.

Disposal of hazardous waste requires considerable engineering expertise. Each site must have various liners under it and monitoring wells around it. Sampling programs must be carried out often and personnel training is a major part of the effort to contain and control a disposal area. Insurance requirements are very specific and coverage must be certified.

Stringent requirements must be met before a site can be closed for good.

These regulations were designed primarily for the chemical manufacturing industry and because of that, EPA did not thoroughly consider the impact its rules would have on industries, such as ours, although, through a great deal of effort, we have made some modifications of the rules that have eased the compliance burden on the railroads somewhat. We do expect to participate in further review and expect to suggest revisions to these rules in the near future, as the new Administration settles in, in Washington.

Comprehensive and Environmental Response Compensation and Liability Act

The last, and perhaps most controversial environmental legislation, was signed into law this past January. The Comprehensive and Environmental Response, Compensation and Liability Act, otherwise known as Super-Fund, provides the federal government with authority to respond to releases or threats of releases of hazardous substances, such as, an abandoned waste dump and other emergencies, such as, derailments involving the release of hazardous materials. Brought about by incidents such as Love Canal and the Valley of the Drums, Super-Fund was furiously opposed by industry as being unnecessary and unconstitutional. It was maintained that government already had mechanisms in place to deal with these chemical emergencies. It was believed to be unconstitutional to penalize industry in general for past practices of an individual company, particularly, if the practice was with the best available technology at that time.

Despite the claims of industry, though, EPA prevailed in its effort to establish this legislation. By leaking the results of their study attempting to link chromosome damage with the Love Canal disaster, EPA created a sensational situation, which no amount of good science could overcome.

Most regulations implementing Super-Fund are not written yet, due, in part, to the change of administrations. We have seen a draft of the latest version of the National Contingency Plan, which gives EPA guidance on what to do with a spill emergency. EPA's response activities may only be implemented if response will not be carried out properly by a responsible party or if such a party is unavailable or unknown. The government has not yet determined what constitutes a proper response, though. As you all know, wording is extremely important when it comes to things like this. The lawyers spend all their time fighting these vague terms for our benefit.

For the time being, however, the federal person assigned to a spill, otherwise known as an on-scene coordinator, has broad powers and judgment. He can, and has, shut down a rail line for several days, if he determines that an Emergency exists.

A good example of this was the derailment at Molino, Florida, last year, which was ultimately blown up by a Red Adaire type under EPA orders.

To assist the railroads in deciding what a responsible party ought to do in an emergency, the AAR has undertaken a spill response research program. We have begun by establishing a comprehensive data base on the top sixty hazardous materials moved by rail. The data base now on our computer has chemical and environmental information as well as toxicological data for each commodity. We have another thirty or so under way for this year.

Next, we have developed emergency action guides for each chemical which contained central response information and includes important environmental information. These guides we expect to be available early next year from our Bureau of Explosives.

We have begun to develop an Engineering Manual for us in the cleanup of spilled materials.

Finally, we have begun development of a medical manual for use by emergency physicians responding to victims exposed to hazardous materials. We hope to make available a service to the AAR members that will enable direct contact with computer models now under development that will predict reaction in movement of hazardous materials on land, water and air. Although we have a long way to go before all of this will be done, I am confident that the results will be extremely valuable to all of us, but at the same time clearly demonstrate our ability to properly respond to spills.

The importance of this work cannot be overstated. Under Super-Fund the railroads' liability is fifty million dollars, plus response costs, per incident. Think about that. That is a great deal of money. You can buy railroads for that kind of money.

It is interesting to note that the water carriers' liability is only three hundred dollars per gross ton, or five million dollars, whichever is the greater. We are working mightily to correct this imbalance. We hope we will be able to reduce that fifty million dollars. If not, we will increase theirs.

Environmental Issues For The '80's

As we can see from Super-Fund and RCRA, control and disposal of toxic chemicals will be a very important challenge to industry in the years to come.

Other issues facing the railroads include ground water pollution from fixed facilities, such as classification yards and fueling areas. As diesel fuel becomes more expensive, alternate fuels will undoubtedly pose new air pollution problems.

Finally, and probably most important, occupational exposure to various chemicals and noise will be more fully explored, both by regulatory people and by scientists. While the pollution control goals that were adopted in the 1970's are likely to remain in place, the methods used to help attain them will certainly change. The environmental regulatory system is a new one and variations in approach will be necessary to make the system work more effectively and with less discord.

That concludes my presentation. I have several copies of an AAR publication entitled "The Path of Least Disturbance," which explains nicely how compatable the railroads are with the environment. I will put them in the back of the room so you may take a copy home with you and look it over. Thank you very much. (Applause)

I would be glad to answer any questions. I really did not intend to provide a detailed explanation of all these rules, but if anyone has any questions, I will be glad to try to answer them. Thank you very much.

President Chambers: Thank you, Mr.

Conlon, and Mr. Michel, for your time and efforts in presenting a very timely subject.

The next speaker will be introduced to you by Mr. Denz. He is a Vice President of the Association and Chairman of the Special Subjects Committee. Mr. Denz.

Mr. Denz. Association members and guests.

It is my pleasure to introduce Mr. H. I. Hayes of International Engineering Company, who will give his presentation on "Modern AC Electric Traction — The Role of the Civil Engineer." International Engineering Company, referred to as IECO, was formed in 1945 as an engineering subsidiary of Morrison-Knudsen Company and has been engaged in the design of railroad facilities and utility systems for over 25 years.

It is recognized as a world leader in railroad electrification engineering and has been responsible for some 350 major engineering projects in fifty countries.

Mr. Hayes is Chief of Overhead Catenary Systems for IECO at San Francisco and he heads a team engaged in overhead contact wire systems design for both main line railroads and transit systems.

Mr. Hayes is a veteran overhead systems Engineer with 27 years combined experience in the United States, South Africa, England and Pakistan. Since 1978 he has been project engineer for the electrification upgrading for the Northeast Corridor Improvement Project between Washington, D.C., and Trenton, New Jersey. At present he is also Project Manager for the electrification of the Moon Lake Coal Haul Railroad in Colorado and Utah.

During the Pueblo Transportation Test Center Electrification project at Pueblo, Colorado, from 1977 to 1978, Mr. Hayes was involved in the design of the 23-mile section of the test track capable of using the catenary styles, the different catenary styles.

On the 530-mile section electrification project in South Africa, Mr. Hayes was the Project Engineer for Design and for construction support during the implementation phase.

As well as being the only 50,000 volt electrified railroad outside the United States, the South African line also has the distinction of being the longest railroad at that voltage level.

I give you Mr. Hayes. (Applause)

Modern AC Electric Traction — The Role of the Civil Engineer

By H. I. HAYES

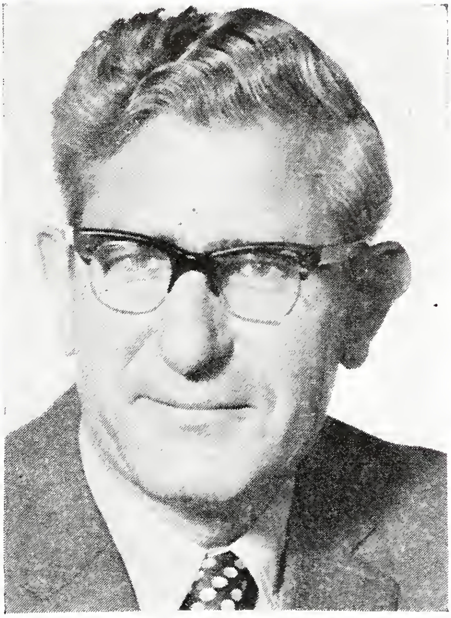
Chief Overhead Cat. Sys. Engr., International Engineering Company, San Francisco, Calif.

Thank you, Mr. Denz. Ladies and gentlemen:

I will preface my remarks by informing you that copies of my paper will be available in the back of the hall. I hope they will be ready by twelve o'clock.

Synopsis

About half the cost of electrifying the main trunk railroads in the U.S. is in civil engineering. This paper describes an overhead catenary system, its installation and its requirements for clearance in tunnels and bridges and other engineering aspects driven by electrification. Track engineers, bridge and building engineers and construction engineers will require to plan on-going maintenance with new construction work. For maximum utilization of track possession time, possession planning must be coordinated with signals engineers and electrification engineers. The resulting installation will be a more efficient railroad built to higher standards but requiring changes to present maintenance procedures. Operationally, shorter journey times will induce more revenue, but higher line capacity will be available.



H. I. Hayes

Two or three conferences are held in this country every year to discuss aspects of railroad electrification. Typically, these conferences recognize that the railroads have an increasing role to play in the nation's economy and that the price of diesel fuel is getting out of hand. Driven by these market forces, presentations generally consider electrification costs, viability and means of financing. The use of available funds, the role of the utilities special financial support from the Federal government, and social benefits, are all addressed.

In view of the very large expenditures involved, much research is made into identifying costs. Feasibility studies have been conducted by several of the major railroads and these are continuously updated. The result of all this effort is a general consensus that electrification is more economical than diesel-electric traction on certain lines, and with diesel fuel prices escalating faster than electric utility rates, electrification can be brought progressively to lesser used routes with even more advantage.

This is what is happening throughout

the world. Since 1960 an average of 2,700 miles of track have been electrified worldwide each year. This is twice the rate of the 1920's and 30's, which was once considered the heyday of railroad electrification.

A study made by the FRA last year identified the economic benefit of electrifying some 10,000 miles of mainline route on eight U.S. railroads as the first priority, followed by a further 16,000 miles later, at a total cost of $20 billion.

The question concerning electrification is not "if" but "when," so it is not surprising that pressure is now placed on engineers to outline in some detail their recommendations for an electrified rail network and the means of implementing the various stages.

Of all the various systems available, high voltage AC traction using an overhead contact system is the most economical choice for main line railroads. However, electrification is not just seen to be a substitution of electric locomotives for diesel, but an opportunity also to use the extra power that is available to reduce journey times. This not only increases line capacity, but attracts new business in view of shorter delivery periods.

Impact of High Voltage Electrification on the Civil Engineer

About 50% of the total investment in electrification is in civil engineering work, namely upgrading track, modifying tunnels, bridges and buildings and installing catenary structures.

This involves track engineers, bridge and building engineers, electrification engineers and constuction engineers in considerable work. Electrification can be a rare opportunity to eliminate a number of undesirable features in the existing system which annually consume a disproportionate amount of the funds available for maintenance: out-of-date buildings, old bridges, restrictive clearances, poor track layout and defective drainage. Also, the present or potential problem of tunnel ventilation will be obviated.

The advent of electric locomotives, which require less than half the maintenance of diesels and a fleet size only about two-thirds that of diesel locomotives in the equivalent operation, will reduce the requirement for maintenance buildings. The increased tractive effort available from electric locomotives permits higher train accelerations and speeds, which place higher stresses on the rails such that the track structure, including under-bridges, will need to be brought to higher standards. The need for electrical clearances in tunnels and bridges, and for the roof linings to be waterproofed, could justify daylighting of tunnels in some instances. Some bridges may be completely replaced, particularly, if road widening schemes are planned by the highway authority at the same time.

Upgrading the track through improved alignment, better layout, and the installation of high-speed, heavy-duty turnouts can be expected to reduce maintenance. The resulting track surface will require closer monitoring and more refined maintenance. This will bring to the track engineers, more sophisticated track analysis vehicles and the latest breed of maintenance equipment.

The overhead contact system brings another dimension to the maintenance operation and this will make an impact on the track engineer's possession time, the equipment he can use and the way in which he can use it. Work necessitating catenary isolations will require additional time for handling work permits and performing the electrical switching. The poles and foundations supporting the catenary need inspection and maintenance. Traction rail bonds and pole bonding need checking, and like the catenary poles, can be obstructions to track maintenance equipment. Headroom is also restricted, making operation of cranes more difficult.

Role of the Civil Engineer

Electrification represents a large investment in fixed equipment which, once installed, is costly to change. It is important, therefore, that the installation be properly designed to satisfy both the short term and the long term objectives of the railway operation. Based on traffic projections, coordinated engineering studies — track improvements, reconstruction for clearance, catenary design and power supply, signals, locomotive specifications and maintenance facilities — will be undertaken to model the electrified rail operation and analyze alternative schemes on a cost-benefit basis.

In addition to their traditional roles, electrification will bring added responsibilities to the civil engineer:

- In coordinating with operations and other railroad disciplines.
- In coordinating with consulting engineers, especially electrification engineers.
- In costing out alternative proposals for track structure and drainage improvement, track renewal and track realignment, and bridge, tunnel and maintenance depot modifications.
- In implementing the project — design review and construction supervision.
- In supervising maintenance of catenary structures, after construction is completed.

Interface with Electrification Engineers

Electrification engineers perform train simulations, design power supply systems, assess electrical interference, write locomotive performance specifications, produce catenary layouts, supervise construction, and commission electrification projects.

The interface between electrification engineers and railway civil engineers involves all tracks and track structures, all bridges, all tunnels, and maintenance buildings. Survey data and information on ground conditions and access roads are also required.

Fundamental to the collaboration between engineers is an appreciation of one another's work, their technological needs, their aims and their problems.

Description of High Voltage Overhead Catenary Equipment

Overhead contact systems supply uninterrupted power sufficient for trains to meet the railroad's operational requirements. In conjunction with locomotive pantographs they provide smooth current collection at normal operating speeds, in all weathers. They are also very reliable and long lasting. Typically the life of contact wire is at least 50 years.

The most economical catenary voltage in use today for open route mainline railroads is 50 kV, but where the provision of clearance is costly, a lower voltage such as 25 kV can be employed.

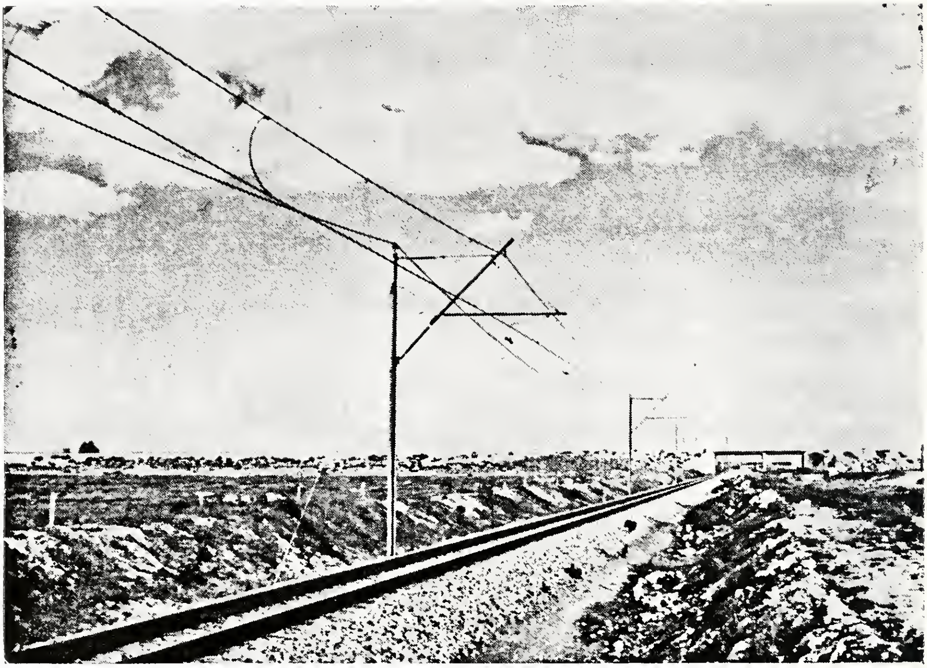
In general, a catenary system for 50 kV only differs from 25 kV by the length of the insulators and increased electrical clearances. Conductor sizes usually are very similar.

Configurations for catenary are various, but for most mainlines in the U.S., where line speeds are less than 100 mph, the so called "simple" catenary is fully adequate. (See Plate 1.) This consists of two bare conductors one vertically above the other, and both supply current. (See Figure 1.)

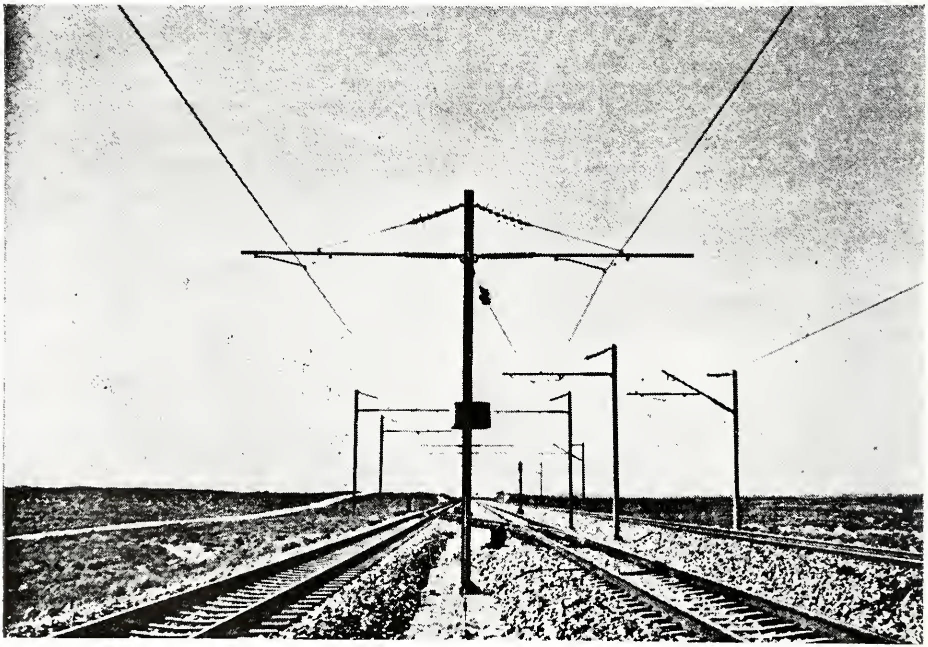
The lower wire (contact wire) is suspended by hangers from the upper (messenger) at intervals of about 30 feet. The messenger wire is supported by single cantilever structures of multi-track structures which are normally 200 to 300 feet apart. A ground/return wire is also required and is normally strung from pole top to pole top.

The height of the contact wire above the track is dependent upon a number of factors. The contact wire is, of course, an overhead transmission line and such electrical clearances must be preserved from the top of all rail vehicles under all climatic conditions. Since these clearance requirements only exist when rail vehicles are present, special minimum recommendations have been made by the AAR/AREA.

MODERN AC TRACTION OVERHEAD CONTACT SYSTEM



Simple catenary on mainline of 50-kV heavy freight railroad



Contact wire system in passing sidings, with mainline on right

PLATE 1

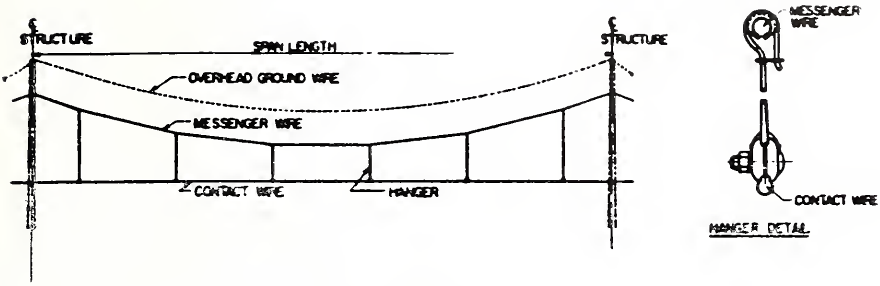


Figure 1
SIMPLE CATENARY

To provide these clearances, allowing for track elevation tolerances and catenary erection tolerances, the contact wire height for a 19 feet high vehicular equipment gage will be between 21 feet and 22 feet. The messenger wire will normally be 3 to 5 feet higher than the contact wire at the supports and will have an appreciable sag at mid-span. The profile of the contact wire is controlled by the length of the hangers, and most modern systems are designed with a 3 to 5-inch "presag" at midspan. This restricts the upward movement of the pantograph at midspan which tends to be greater than at the supports due to differential "stiffness" of the catenary. Presag improves current collection at higher speeds and prevents sparking, thereby lengthening contact wire life.

Simple catenaries carrying 600-900 amperes normally consist of a solid grooved copper contact wire 0.4 inch in diameter and a slightly larger diameter composite steel/aluminum messenger. Then tension in each wire will be typically 2000-3000 lbs. and will be kept constant by counterweights. (See Figure 2.)

This "automatic tensioning" ensures that current collection capability is uniform throughout the broad range of conductor temperatures from well below freezing up to 170°F — a temperature which can be achieved through a high ambient and sustained high amperage. In this constant tension system, temperature changes in the conductors are accommodated by rise and fall of the counterweights. This is facilitated by allowing the catenary support arms to rotate along track on the poles. (See Figure 3.)

However, as the crossarms swing around the poles on their hinges they draw the contact wire toward the poles and thus away from track centerline. In order to control this displacement, maximum along track movement is limited to about 3 feet. This is achieved by dividing the catenary into tension sections of approximately 1 mile in length, which are overlapped without mechanical connection. (See Figure 4.)

The locomotive pantograph rides smoothly from one tension section to the next without loss of power, electrical continuity being provided by flexible jumper connections between the overlapping catenaries.

On single-track railroads, the catenary poles are positioned approximately 10 feet from the track centerline, depending on track curvature.

On double tracks and in sidings, a back-to-back arrangement is possible from a single pole located between them, if space permits. (See Figure 7.)

In yards and sidings reduced clearance may be acceptable and poles can generally be accommodated between tracks with 15 feet track centers.

Where inadequate clearance is available to locate poles between tracks, multi-track structures such as portals and headspans can be used. (See Figure 5.) On multi-track portal structures, the crossarms are swung from drop brackets.

COUNTERWEIGHT

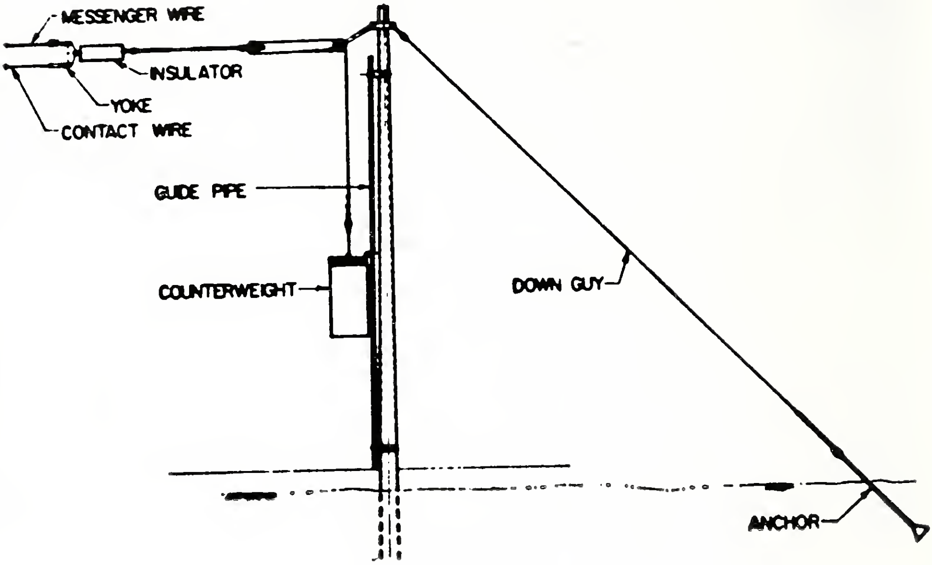


Figure 2

An alternative to crossarms is for the catenary to be supported from pulley wheels to accommodate thermal elongation of conductors.

In order to distribute wear across the carbon collectors of the pantograph the contact wire is offset from the centerline of track by up to 12 inches by the use of registration arms at each catenary support structure. On straight track, this "stagger" is alternated at successive supports thereby inducing "sweep" of the pantograph carbons. On curves the staggers do not alternate; instead the contact wire is registered to the outside of the track at all supports, forming chords around the curve with attendant sweep. (See Figure 6.)

For maximum economy catenary supports are positioned as far apart as possible bearing in mind a number of limiting factors:

- Blow off (lateral deflection) of the contact wire by wind.
- Track alignment and cross level tolerances.
- Locomotive and pantograph sway.
- Track curvature.

CROSSARM

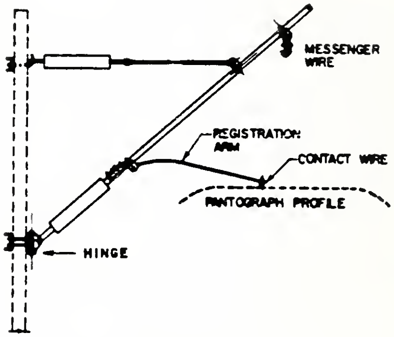


Figure 3

- Pantograph width.

On tangent tracks, span lengths are typically 200 to 300 feet, but may be reduced to avoid obstructions.

On curves the "chording" by the contact wire will usually require that span lengths be reduced in order to keep the wire in the correct positional relationship with the track at midspan. Typically, spans on curves of 3° are 150 feet,

OVERLAP OF TENSION SECTIONS

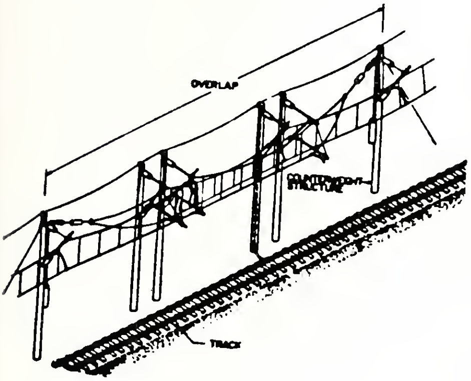


Figure 4

on curves of 5° about 120 feet, and on curves of 10° about 80 feet.

Every catenary support structure saved is not only less initial material cost and less installation cost, but less track occupancy for installation, and less maintenance. Because of this, considerable care is taken in laying out structures for maximum economy. However, as a consequence it is essential to recognize that the position of the catenary with respect to the track is critical.

A less costly alternative to the simple catenary which can be used where current demand is low and poles are closely spaced, due to curvature such as in loops and yards, is a single contact wire at the same high voltage but without a messenger. (See Figure 7.) The contact wire is directly suspended at each crossarm without intermediate support, but to restrict the amount of sag, span lengths are limited to 150 feet. Just as with the simple catenary system, automatic tensioning of this "contact only" system is desirable.

The use of simple catenary on mainlines complemented by the "contact only" system in loops and yards is practical and economic. Considerable standardization of components is possible by careful selection of components and the use of the same type of contact wire.

PORTAL STRUCTURE

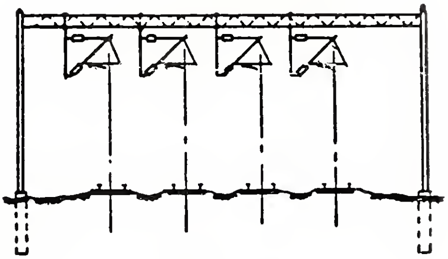


Figure 5(a)

HEADSPAN STRUCTURE

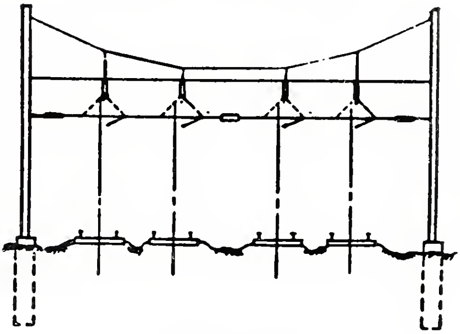


Figure 5(b)

Reconstruction of Existing Structures for Electrical Clearance

Equipment gage impacts directly and very significantly on the cost of electrification.

The selected equipment gage warrants examination and confirmation by the operators before electrification proceeds. To provide a higher gage after electrification will be very costly. On the other hand any unnecessarily excessive requirement declared for electrification can increase considerably the cost of providing adequate clearance in substandard tunnels and bridges.

Most pantographs in the U.S. will collect current over a height range of about 6 feet, so that the provision of additional clearance over grade crossings or in yards does not conflict with the need for minimum catenary heights in tunnels and bridges.

CONTACT WIRE STAGGERS

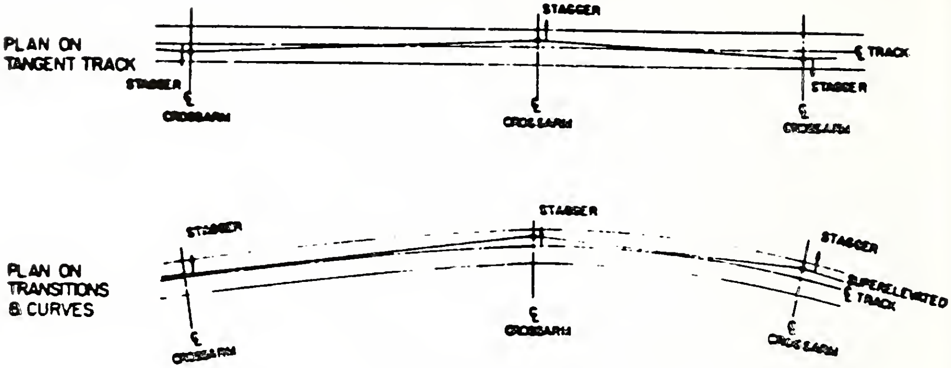


Figure 6

In open track with no vertical height constraints the contact wire will normally be at about 22 feet.

Where space is limited, such as in tunnels and through bridges, the wire height must be reduced as much as possible. This is achieved by shortening the spans. On a short span, the sag of the contact wire under worst conditions (ice load or high temperature) is reduced and, therefore, the contact wire can be lowered at the structures without infringing on the required clearance to the rolling stock. At the same time the messenger wire height can be reduced very much more since its sag in a short span is less than in a long span. By using the walls or roof for support of the special crossarms, and spacing them as close as 25 feet, the two wires need be only inches apart. (See Figure 8.)

In this way the minimum height required from the equipment gage to the roof is in the order of 19 inches for 25 kV and 33 inches for 50 kV. These figures may vary according to allowances for vehicle bounce and track tolerances and can be marginally less in specific cases.

With a 19 foot high equipment gage and minimum wire heights the minimum headroom for 50 kV is therefore about 22 feet and for 25 kV is about 20 feet 6 inches in order to accommodate the conductors. Supports for the conductors also require electrical clearance, and therefore special pockets, up to 9 inches deep, may have to be cut into the crown of the arch every 20 to 30 feet, if the headroom is particularly restrictive.

The shape of the crown of the tunnel is also critical. The locomotive pantograph is live across its full width, and electrical clearance is required at all times from both tips to the tunnel lining.

Typical pantographs are 6 to 7 feet wide, but because allowance must be made for sway, the required width of a tunnel at pantograph height will need to be about 12 feet for 25 kV and 13 feet 6 inches for 50 kV. Lack of such clearances may lead to considerations of a narrower pantograph, but this is in direct conflict with economic structure spacing outside the tunnels, since larger pantographs permit much longer spans. The cost comparison of these alternatives warrants the highest level of input from civil engineers since both pantograph width and choice of operating voltage largely depends upon this analysis.

However, the ultimate selection of the pantograph width must take due regard of possible interchange with other railroads.

Catenary Construction

The largest cost item in catenary in-

CONTACT ONLY SYSTEM
ON BACK-TO-BACK CROSSARMS

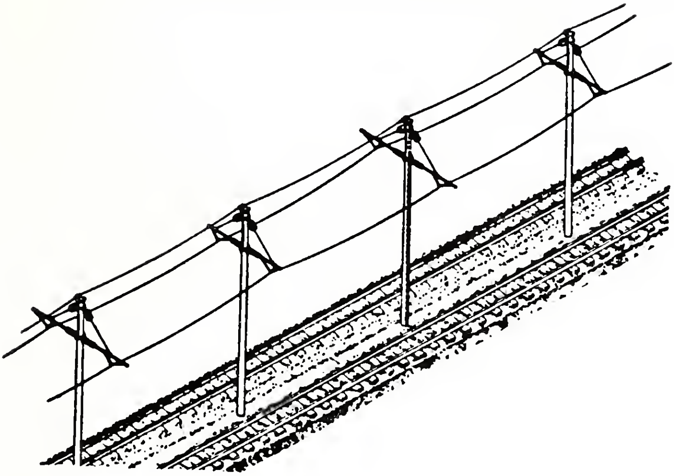


Figure 7

TUNNEL SUPPORT

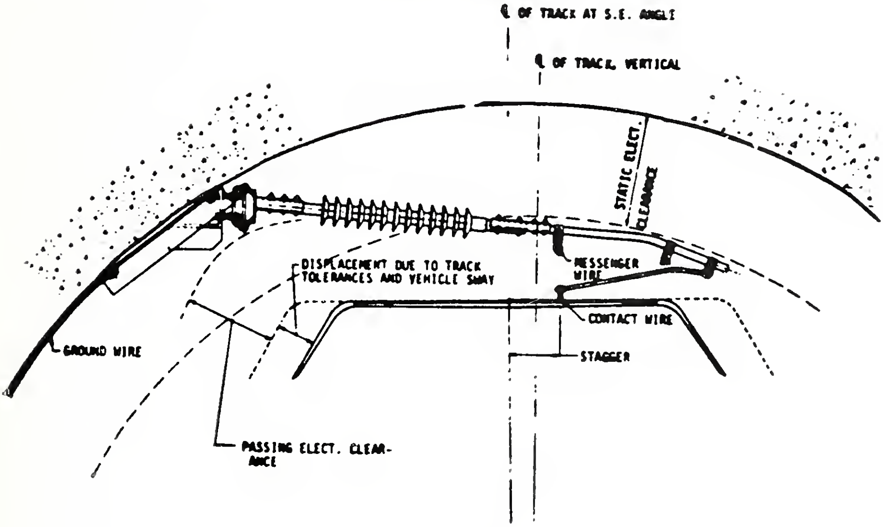


Figure 8

stallation is for structures and foundations. It is important therefore that the civil engineer analyze in considerable depth the costs of supplying and installing catenary poles, portals and headspans.

The following aspects apply in pole selection.

- Suitability, availability and adaptability of alternate pole types.
- Track possession time for installation.
- On-track and off-track installation equipment.
- Differing soil conditions.
- First cost of pole and foundation.
- Standardization.
- Maintenance costs.

Poles may be either self-supporting or guyed. The trend abroad is to opt for self-supporting poles mainly because of space limitations—tracks tend to be constrained by boundaries, lineside buildings or other tracks. Down guys, even when space is available, are viewed as avoidable obstructions which would unnecessarily limit future track remodeling.

The material most economically suited to these requirements is steel, and poles made of galvanized steel I-beams have the benefit of being slender, adaptable (cut, drill and weld) and dependable (distort rather than break when struck in a derailment). However, in this country the very openness of the railroads and relatively wider rights-of-way could find economic merit in using the guyed wood pole, particularly on main lines. Concrete poles are also an option to be considered. Although heavy and brittle, once installed they are easy to maintain and pleasing in appearance.

Both wood and concrete can be directly embedded into the ground, but steel is usually cast into concrete. Fabricated steel poles are not favored because they can be more easily climbed by trespassers, with fatal results. Also, painting tends to favor the visible parts and miss the weld pockets where corrosion is most likely. Aluminum and fiberglass and some patent poles have been considered but are generally not economical. (See Table 1.)

In designs for multi-track structures the material chosen for the columns is likely to be the same as selected for single poles. However, the beams for portals are normally fabricated steel. Headspans use galvanized steel, copper-clad steel or stainless steel stranded cables. The choice between the use of portals and headspans or whether to use a combination of both is based upon site-specific requirements, aesthetics and economics. (See Table 2.)

Installation of poles is a subject given much attention by civil engineers. Looked at in hard economic terms, the placement cost per pole is very high when the cost of the track possession, in terms of disruptions to train schedules, is added to the practical engineering problems of specialized equipment and the general remoteness from the construction depot.

Since rail access is always possible the trend in construction is to develop specialized rail borne equipment with high production capability and fitted with off-tracking gear. However, if possession time is very limited, either in duration or frequency, there is considerable advantage to working with off-track equipment even at some increase in material, equipment and labor cost. Vehicles with dual capability are valuable for foundation excavation and pole erection since they can work off-track only using the track "between trains" for difficult accesses and for advancing along the route.

Longer activities, particularly conductor stringing, are best handled from on-track vehicles. Lighter duties may be catered to with Hi-rail vehicles. (See Plate 2.) The use of self-propelled elevating platforms with off-tracking capability for light work in the catenary can be explored.

The design of poles and foundations for railroad electrification has received considerable attention of late. Steel poles designed to AISC codes have been found in some cases to be unnecessarily heavy. Methods of analysis using beam-column theory verified by laboratory and field testing have therefore been devel-

TABLE 1

		Steel-Galvanized					
Factor	Weathering steel	I-Beam	Fabricated	Painted Steel	Concrete	Wood (Guyed)	Fiber-Glass
Material cost	Good	Fair	Good	Good	Good	Good	Poor
Weather resistance	Good	Good	Fair	Poor	Good	Good	Good
Handling—resistance to damage	Good	Good	Fair	Poor	Poor	Good	Fair
Grounding facility	Good	Good	Good	Poor	Poor	Poor	Poor
Transportation—weight	Fair	Fair	Good	Fair	Poor	Good	Good
Drilling capability	Good	Good	Fair	Good	Poor	Good	Good
Clamping capability	Good	Good	Good	Fair	Good	Good	Fair
Strengthening capability	Good	Good	Good	Good	Poor	Poor	Poor
Withstanding deflection	Good	Good	Good	Good	Fair	Fair	Fair
Availability from stock	Good	Fair	Poor	Good	Good	Good	Poor
Lengthening capability on site	Good	Good	Fair	Good	Poor	Poor	Poor

Note: Adjectives describe economy.

oped which enable smaller pole sizes to be selected than the simplified AISC approach would require.

Considerable economies have also been achieved in designing pole foundations for cantilever loads using criteria developed by the Texas Highway Department for cantilever road signs. However, the suitability or adequacy of any foundation is finally a matter of engineering judgment taken in the light of prevailing soil conditions by the man on the spot.

One solution to the problem of installing steel poles which was tried with great success on the recent Sishen-Saldanha Project in Africa, utilized concrete sleeves. These were 2 feet O.D. and of three lengths: 6 feet 6 inches, 8 feet and 11 feet. When backfilled and compacted these not only had a core hole in which an I-beam could be placed and grouted, but provided an excellent uniform base to receive a jig to hold the pole while the grout set. Since the sleeves were pre-cast, concrete quality was more easily achieved than it would be if mixed in-situ. And, of course, the finished appearance of the sleeve was excellent.

Of the total of some 16,000 foundations on 540 miles of route, about 30% could not use the standard sleeve due to the presence of underlying rock. Two optional foundations were developed either of which could easily be adapted on site to the specific needs of any location. (See Figure 9.)

Both designs use a sleeve which is cut to suit the level of the underlying rock. Since one of the designs calls for a pole with base plate, it is necessary to have two types of pole available, which are reordered on a "use" basis. By catering to the needs of a specific pole location by this principle of optional design it is unnecessary to trial-hole every foundation ahead of installation.

TABLE 2

Factor	Preference	Reason
Size of foundation	Portal	Much smaller than for headspan
Large cross-track spans (e.g. over 75 ft)	Headspan	Portal bridge is heavy
Use in bad ground	Portal	Smaller need for side bearing strength
On viaducts	Portal	Smaller moments on viaduct
Installation	Headspan	Portal bridge requires all tracks closed
Standardization of span widths	Headspan	Cross track dimension fully variable
Independence of each catenary	Portal	No interconnection at contact level
Painting of steelwork	Headspan	Isolation required to paint portal bridge
Signal sighting	Headspan	No bridge to obstruct sighting of signal
Environmental impact—visibility	Headspan	Less visible
Environmental impact—height	Portal	Lower profile
Anchor structures	Anchor/Headspan	More economic, less visible than portal

Bore holes on a spot basis are useful as a general indicator of ground composition and condition, but cannot be normally relied on for precise design. Better by far to drill a standard hole and identify the need or otherwise for extra depth or special design and cater to it.

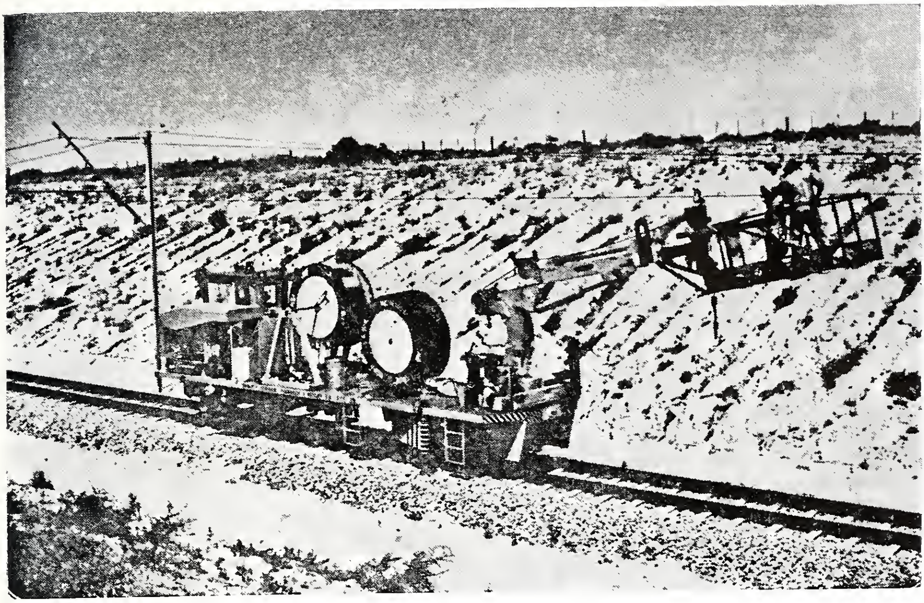
An attendant aspect of foundation installation is the hardy perennial of ballast contamination by excavated soil. This is wholly avoidable by proper preparation and supervision. The same applies to drainage ditches and culverts, which can inadvertently be filled with grout or concrete when surplus material is being disposed. The construction engineer must specify to the foundation contractor where he can wash out his mixers, and must keep tight control of the contractor's work.

Planning Electrification

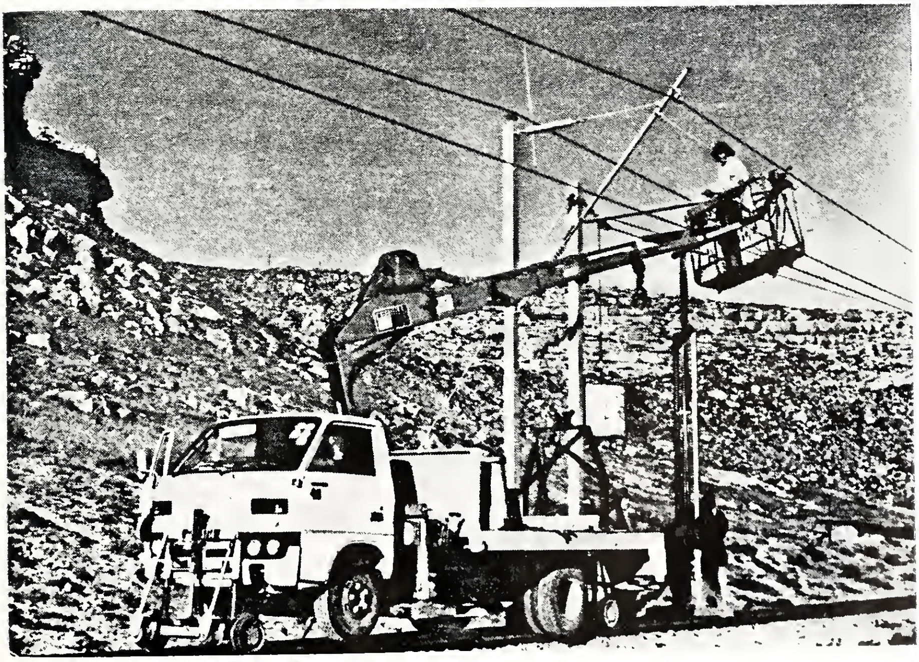
Besides the civil engineering activities involved in electrification, it will probably be necessary to upgrade or convert signalling systems, train control and communications equipment. Planning electrification is therefore a team activity. After the operations staff have prepared short and long term train schedules, the iterative process of evaluating cost-benefits of alternative train operating arrangements will require track alignment studies and the preparation of signalling schemes for a variety of train speeds. Train simulations based upon train weight, locomotive performance and improved track alignment will take considerable time. Catenary design and layout based on selected alternatives will need to be developed.

The ensuing designs must meet the objectives of constructibility, low maintenance, flexibility of installations and ease of repair, but above all, they must be coordinated. This will be facilitated by the early completion of a fully detailed along-track survey of the existing tracks and all trackside features. The data provided will serve for checking existing records and enable a compre-

TYPICAL CATENARY CONSTRUCTION VEHICLES



Conductor stringing vehicle with off-tracking capability



Dual mode Hi-rail truck for light duties

PLATE 2

ROCK FOUNDATION: POLE EMBEDDED

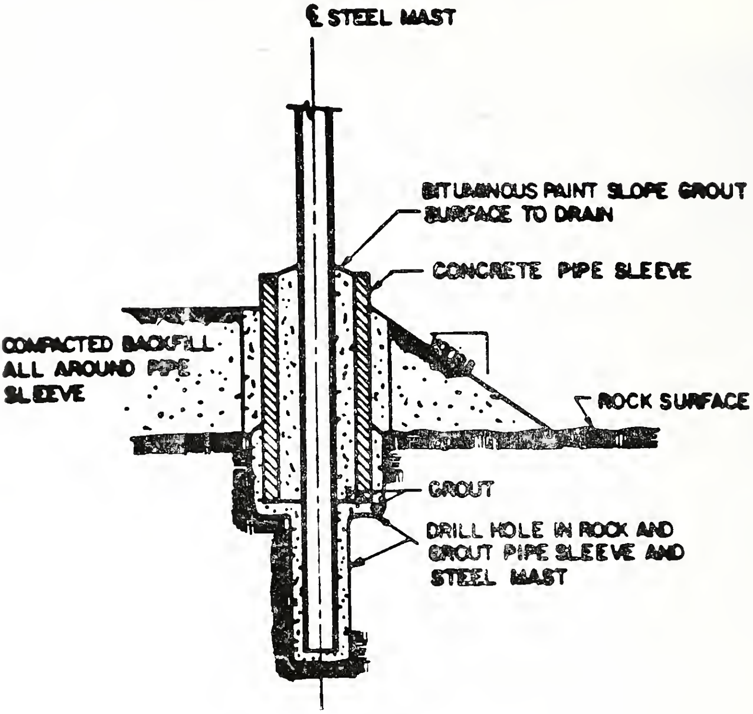

℄ STEEL MAST
BITUMINOUS PAINT SLOPE GROUT SURFACE TO DRAIN
CONCRETE PIPE SLEEVE
COMPACTED BACKFILL ALL AROUND PIPE SLEEVE
ROCK SURFACE
GROUT
DRILL HOLE IN ROCK AND GROUT PIPE SLEEVE AND STEEL MAST

Figure 9(a)

ROCK FOUNDATION: BOLTED TYPE

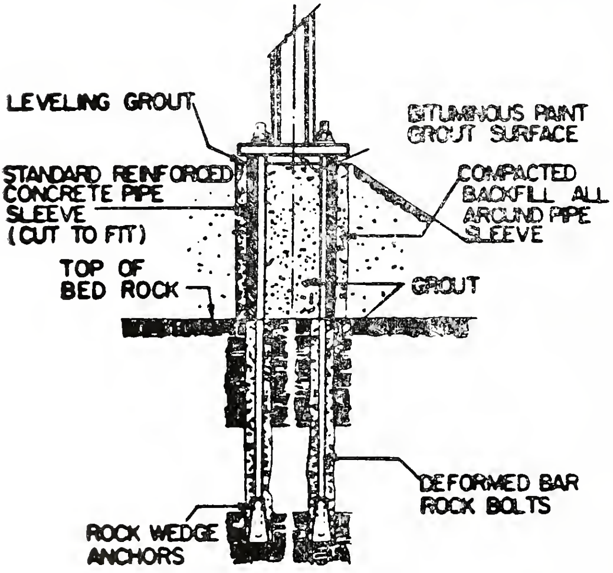

LEVELING GROUT
BITUMINOUS PAINT GROUT SURFACE
STANDARD REINFORCED CONCRETE PIPE SLEEVE (CUT TO FIT)
COMPACTED BACKFILL ALL AROUND PIPE SLEEVE
TOP OF BED ROCK
GROUT
DEFORMED BAR ROCK BOLTS
ROCK WEDGE ANCHORS

Figure 9(b)

hensive integrated system of alignment markers and bench marks to be set out on the whole of the route. Photographs taken in each direction at 1/4-mile intervals and issued to all offices will also prove invaluable.

In addition to the on-going civil engineering maintenance, an electrification project requires new track, new signals and signal cables, structure reconstruction, plus the entire catenary installation. This increased level of activity on-track will place considerable pressure both on the operators and engineers in order to complete the electrification programs as quickly as possible.

The staging of trackwork, civil reconstruction, and new signals should preferably precede catenary installation. Attention should always be given to fully utilize construction equipment and labor to perform planned work during the hours of daylight. Work on-track should be geared to a 6 to 8-hour possession every weekday with total possession of junctions on one day at the weekend. In order to maximize on available possessions, joint possession planning is desirable, after which the coordinated requirements of the various disciplines can be directed to the operators. To facilitate train operations, temporary turnouts and connections may be required. To facilitate off-tracking the construction equipment, additional temporary off-track standings and additional temporary grade crossings may need to be installed.

The key to economical railway electrification is very much the efficient use of track possession time. A great advantage will be found in coordinating the work of various disciplines especially if the same construction equipment is suitable. Integrated planning will benefit from the synergism within the team, where the exchange of ideas can, if promoted, produce the most beneficial results, short term and long term, for any individual railroad.

Electrification is coming, and all of us in the industry must be ready. This is the challenge, whatever our role.

President Chambers: Thank you, Mr. Hayes and Mr. Denz, for a very knowledgeable report, and sharing this report with us. Thank you very much.

I want to remind you some copies of this report are available in the back.

This concludes the second and final Joint Session of the Roadmasters and Bridge & Building Association at this Conference.

The Roadmasters and the B & B will meet in their separate rooms after lunch. The doors will be labeled outside.

Please assemble promptly, as we both have a full schedule.

President Sorrels, do you have anything further?

President Sorrels: No.

President Chambers: I declare this Joint Session adjourned.

. . . Recessed at 11:27 A.M. . . .

TUESDAY AFTERNOON SESSION

September 15, 1981

President Chambers: The meeting will please come to order.

The second meeting of our 86th Annual Conference is now in session.

Please close the doors.

— Pause —

First, I would like to recognize our past presidents who are in attendance this afternoon.

Will Mr. Gould, our immediate past president, make the introductions?

W. C. Sturm, J. R. Iwinski, W. H. Rankin, E. E. Runde, T. L. Fuller, W. F. Armstrong, R. D. Hellweg, H. M. Wilson.

President Chambers: Thank you, Mr. Gould, and on behalf of myself and the association thank you, gentlemen, for attending.

President Chambers: The nominating committee is composed of the five most recent past presidents. The chairman of this committee is our most recent past president, Mr. Gould.

At this time he will present to you the selections of that committee for officers and directors to serve the association for the coming year.

Report of Nominating Committee

Mr. Gould: The nominating committee of the American Railway Bridge and Building Association respectfully submit to the membership the following slate of Officers and Directors with the recommendation that they be elected for the terms specified:

For President—
    W. R. Hyma, Bridge Engineer System, Santa Fe, Chicago
For Senior Vice President—
    O. C. Denz, Supervisor Bridge Maintenance, Milwaukee Road, Chicago
For Junior Vice Presidents—
    James Budzileni, Senior Structural Designer, Illinois Central Gulf, Chicago
    J. M. Williams, Supervisor Bridge & Building, Elgin, Joliet and Eastern, Gary, Ind.
For Directors for Terms expiring in 1984—
    A. S. Uppal, Engineer Bridge & Structure Mtce., Canadian National Rail, Montreal, Que. Canada
    H. J. Laga, Asst. Environmental Engineer, Chicago & North Western, Chicago
    J. W. Davidson, Asst. Director Bridge Engineer, Burlington Northern, St. Paul, Minn.
For Secretary—
    Patricia Weissmann
For Treasurer—
    W. F. Armstrong, Engineer Buildings, Chicago & North Western, Chicago

Additional candidates may be nominated from the floor. The election will be held following tomorrow morning's program.

President Chambers: Thank you, Mr. Gould. Additional candidates may be nominated from the floor.

The election will be held at the closing session tomorrow.

President Chambers: I would like Mr. Russell to come forward to introduce the first speaker this afternoon.

Mr. Russell: I would like to present to you at this time Mr. John C. Calhoun, who will speak to you on the subject of "Trestle and Short Span Bridge Renewal." Mr. Calhoun is Bridge and Building Supervisor for the Southern Railroad, Chattanooga, Tennessee. Mr. Calhoun.

Trestle and Short Span Bridge Renewal

By JOHN C. CALHOUN

Bridge & Building Supervisor, Southern, Chattanooga, Tenn.

My presentation today will deal with three different type projects and will consist of a narrative supplemented with slides. The three types to be covered are:

1. Outright replacement of timber trestles with steel ballast deck trestles.
2. Replacement of open deck and/or ballast deck timber trestles with steel open deck trestles.
3. Replacement of timber stringers and caps with steel open deck stringers and concrete caps.

The renewal projects we will cover were completed under traffic, utilizing slow orders and standard flagging procedures.

Although most projects never completely follow their original procedural concept, nevertheless a plan must be in existence. We are talking about a plan in addition to the engineered blueprint. What it amounts to is a detailed, chronological checklist. Here are some highlights from such a list.

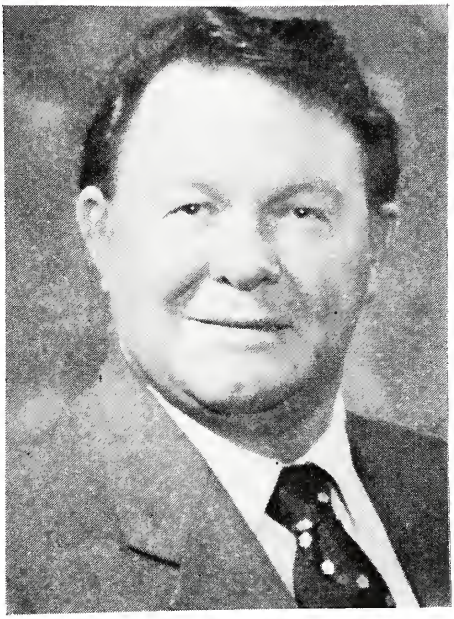
Highlights of the Checklist

When material for a project is received, it must be promptly unloaded. During the unloading, it must be properly inventoried to prevent surprise shortages later.

A staging area must be provided for fabrication of components and/or storage of fabricated components. This area is located as close as is practical to the project site to minimize movement.

A clearance ramp for a pile drive must be constructed in advance of project start-up time.

The piling to be used are placed alongside the structure as close as is practical. Of course, the physical terrain will sometimes prevent this.

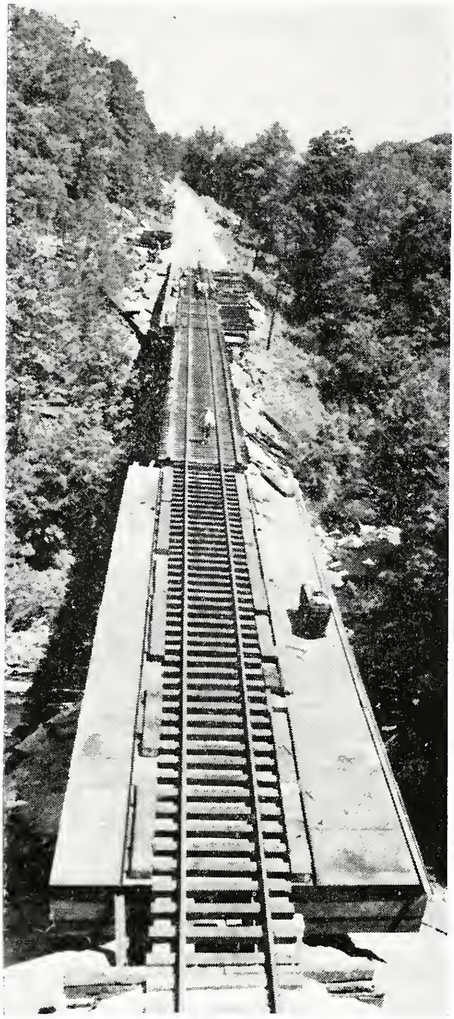


John C. Calhoun

Steps of Renewal for Open Deck Structures

Ballast is removed over the proposed bents. We call this "digging out checks." Holes are then cut in the timber deck through which the "H" piling or pipe piling are to be driven. This opening also provides a partial template with which to maintain batter if needed. The old ties used for cribbing are also ballast end dams, keeping the integral stability of the old ballast section intact. This will allow a higher slow order (usually 25 MPH) to be used for a longer period before the actual removal of the old structure.

In the case of driving piling in open deck timber structures, the timber



Steel ballast deck approaches. Nearing completion. Near Birmingham, Ala. Southern Railway.

stringers are moved sidewise as necessary, a temporary cut-off of the piling is made, the stringers returned to their proper position and redrifted. Usually the bracing of the new bents follows closely behind the pile driving, as does the final cutoff and placement of caps.

Where practical, the fabricated load stringers, and the single intermediate stringers are brought out alongside the old structures and placed on the ends of the new caps. Or, if room is available, they may be placed on the ground *opposite* the side toward which the old timber supporting members will be removed. As many other steel components should be brought as close as possible, utilizing short stretches of track time between trains.

Now the removal of the old timber structure begins. The method of removal depends upon the condition of the adjacent ground alongside. If access by a dozer, loader, or other type of machine with a winch can be had, so much the better. If such access is not available, then the removal process must be from the topside.

Usually, beginning at one end of the old structure, the timber stringers are cut over the center of the next new bent. We use a minimum of three (3) heavy-duty, gasoline-powered chain saws, two to cut with and one on standby. The old bent(s) are pulled from under the first new panel, out to the side, and out of the way. It leaves quite a hole. The four load-bearing stringers are placed in position and the anchor bolts are dropped into their holes. They always fit, naturally! At this point, you could run a train(s) if you had to. It is also the time when new ties can be installed if it is to be open deck.

Ballast Deck Trestle

If the project is to be a ballast deck trestle, our particular design calls for three additional single stringers to be placed to complete the panel, two on one side of the load-bearing stringers (for a vehicular walk/drive way) and one on the other side. The half-inch steel deck plate is then installed. (Track time sometimes will not allow the deck plate to be installed at this point. In that case, timber sleepers of the necessary thickness—to maintain the proper surface—are placed on the top flange of each load-bearing stringer. It is better to await sufficient track time.

A gaping hole can be seen when the old timber bents and stringers were removed. The obviously good ties were double-spiked beforehand. The not-so-good ties fall to the ground when the hole is opened.

Now, we have sufficient track time (at least one hour) so the steel deck plate is installed. Timber sleepers are inserted between the deck plate and the ties. During this phase of the conversion, extreme care must be taken to prevent the track from shifting when the air temperature climbs into the 80's. Struts, chains and binders may be used. In double track, the track on the structure being worked may be strutted off, and bound to, the adjoining secured track.

The ties are drifted to the sleepers. The sleepers are secured to the deck plate by steel tabs (cut from scrap steel) tack welded to the plate to prevent both lateral and vertical movement.

The next span is ready for replacement when track time permits and so on until the last span is set. Ballast guards are added. The steel deck is then ready for greasing with preservative. Ballast is unloaded from hopper cars and spread with a switch tie. The sleepers are removed; the track is surfaced; surfaced again. When sufficient tonnage has passed and stability is evident, the slow order is removed.

The underside of the structure is then greased. The time for final cleanup begins. Scrap steel, pile cutoffs, old timber, everything unsightly.

Installing Steel Stringers And Concrete Caps

Installing steel stringers and concrete caps is a somewhat simpler operation. The timber stringers are freed from the caps, drifts are cut between cap and piling, old cap is removed, new cut-off of piling is made, timber stringer section is removed, new concrete cap is installed. These last two steps are sometimes reversed. If more than one panel of steel stringers are to be installed, all the caps are changed out first. When two separate crews are available, of course, the stringer replacement can begin when the first crew is a sufficient distance ahead.

The concrete caps are drifted to the timber piling and the steel stringers are secured to them with hold-down plates and bolts.

Essential Factors

Coordination and cooperation with other departments are essential factors in any plan. Access to the job site across outsider's property is sometimes a must.

Track time has to be arranged; the signal department has to move wires and/or cables prior to commencing; power utility has to be notified; restoration of company pole or conduit lines is arranged; work trains for material delivery and unloading ballast are requested; smoothing machines are requested far enough in advance.

Clean-up can be a time-consuming (and overlooked) item if it is not partially done as a project progresses. Vacation(s) of personnel is a hidden factor, as is sub-surface obstructions, such as boulders, old pile heads, stumps, even pieces of steel from ancient disasters.

I purposely left one factor until the last so that you would leave with it fresh on your mind—that's the *SAFETY FACTOR*. No project, regardless of how imposing and efficient it is, can be called a "success" unless it has been completed safely. Whatever it takes—monthly, weekly, daily, hourly reminders—is not too much to do to make a project, and its men, safe. Only then can you look upon your handiwork with justifiable pride.

President Chambers: Thank you Mr. Russell and Mr. Calhoun, your report was most timely, interesting and useful. It conveys information in the best tradition of our Association.

Would Mr. Lewis please introduce the next speaker.

SPECIAL SUBJECTS COMMITTEE REPORT NO. 2

Evaluation and Repair of Fire Damaged Steel Bridges

COMMITTEE—A. SHAKOOR UPPAL, *Chairman*, Engineer, B&S Maintenance, CN Rail, Montreal, Canada; D. J. STARRETT, Engineer Construction Bridges, ConRail, Villas, NJ; D. S. BECHLY, Engineer-Structures, ICGRR, Chicago, IL; W. G. BYERS, Bridge Engineer, AT&SF RR, Amarillo, Texas; D. K. FRANZ, Bridge Inspector, C.M.St.P&P RR, Chicago, IL; B. J. KING, Bridge Engineer, AT&SF RR, Los Angeles, CA; D. R. LADNER, Assist. Engineer, C&NWT Co., Boone, IA. *Sponsor*: D. J. LEWIS, St. Structural Designer, ICG RR, Chicago, IL. *Special compliments for providing valuable assistance in preparation of the report*: Z. L. SZELISKI, Asst. Chief Engineer-Design & Construction, CN Rail, Montreal, Canada; N. M. ENGELMAN, System Engineer-Bridges and Structures, CN Rail, Montreal, Canada; C. R. WAHLEN, Assist. Engineer Bridges, AT&SF RR, Chicago, IL.

A. S. Uppal

Introduction

Railroad bridge fires may be attributed to the following main causes.

(i) Natural: These are grass or forest fires triggered by lightning, earthquakes or other natural causes.

(ii) Accidental: These include a variety of causes, such as falling of hot metal from brake shoes, burnt out journals or sparks from locomotives or trolley wires; escape of flammable substance on account of a derailment or a collision; or carelessness while working, such as using torch for cutting steel, welding, sawing and grinding rails; dropping fusee, burning remains of old ties or picnicking in the vicinity of a bridge.

(iii) Vandalism: Fires purposely set to cause damage to railroad property.

The main ingredient of fire on a steel bridge is the presence of timber either in the form of its deck, part of its substructure or may even be a tree or shrub growing in its immediate proximity. Items which increase bridge fire susceptibility are: creosote treatment, oil drips from locomotives and spills of flammable commodities during a train derailment or vehicle collision.

Some railroads do maintain statistics of damages attributed to fires. See Figure 1.

To understand the effects of fire on a steel span we have to find out how and where the fire started and how it traveled across the bridge. What was the damage to different components of the bridge? Since it is not possible to measure temperatures during the course of a fire, one should look for telltales, such as change in the color of paint, oxidation of steel, change in geometry, etc., to make an assessment of the temperatures which might have been reached during the fire.

Bridge Fires

The damage resulting from bridge fires depends on the type and the quantity of combustible material, the prevailing temperatures, direction and velocity of wind, the relative humidity of the atmosphere and the characteristics of the steel structure. Furthermore, the heat transfer from the fire to the steel of a bridge both by conduction and radiation depends on the fire load, its duration, the distance, the difference of temperatures and the ratio of the fire exposed area to its volume for the same length of the different components of the bridge structure. This means that a component having a larger ratio will take less time to reach a high temperature than a component with a smaller ratio.

In the majority of instances, bridge fires have been in the bridge decks, either because the fire started there or because it had spread from another part of the structure. It, therefore, would seem to be a logical strategy to minimize the susceptibility of the bridge deck to fire in a plan to prevent fire damage to bridges.

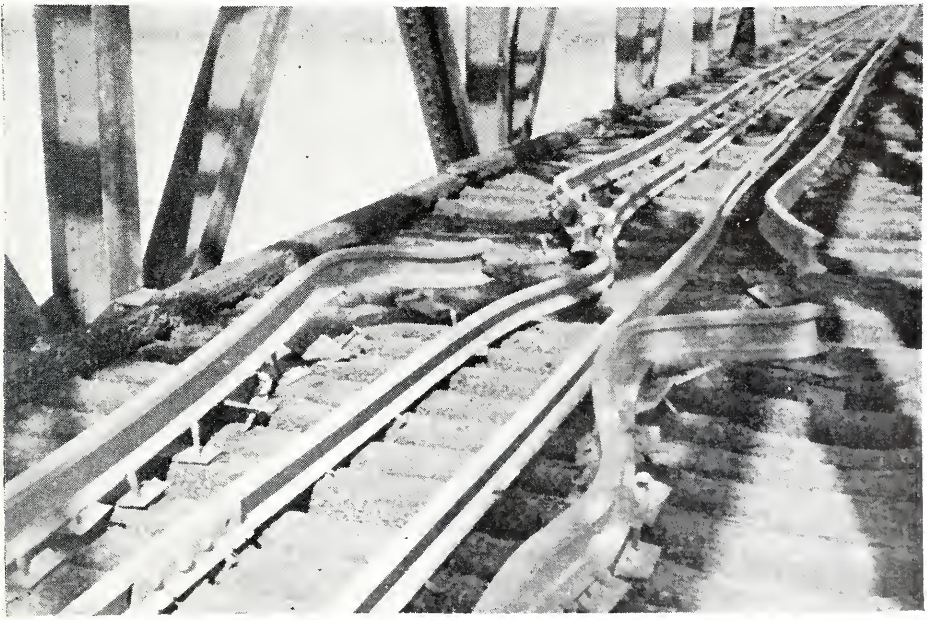
(a) Characteristics

The following characteristics of a bridge fire and the structural steel involved should be borne in mind:

(i) In most cases when the effect of fire is gradual and uniform and the span is free to expand and contract, no damage to steel would result except possibly above the lower transformation level (i.e., 1300°F) when the metallurgy could be affected.

(ii) Fire often starts at one point and travels across the bridge. The initial effect of fire is generally of localized nature and seldom results in uniform heating of the bridge span. Heating causes expansion of metal which depending on the characteristics of the members and the intensity of heat may cause elongation, warping or twisting of the members. See Figure 2.

(iii) As the heat transfer takes place, the rise in temperature in different members and their components would be directly proportional to their proximity



Fire Damage to bridge.

BRIDGE FIRES

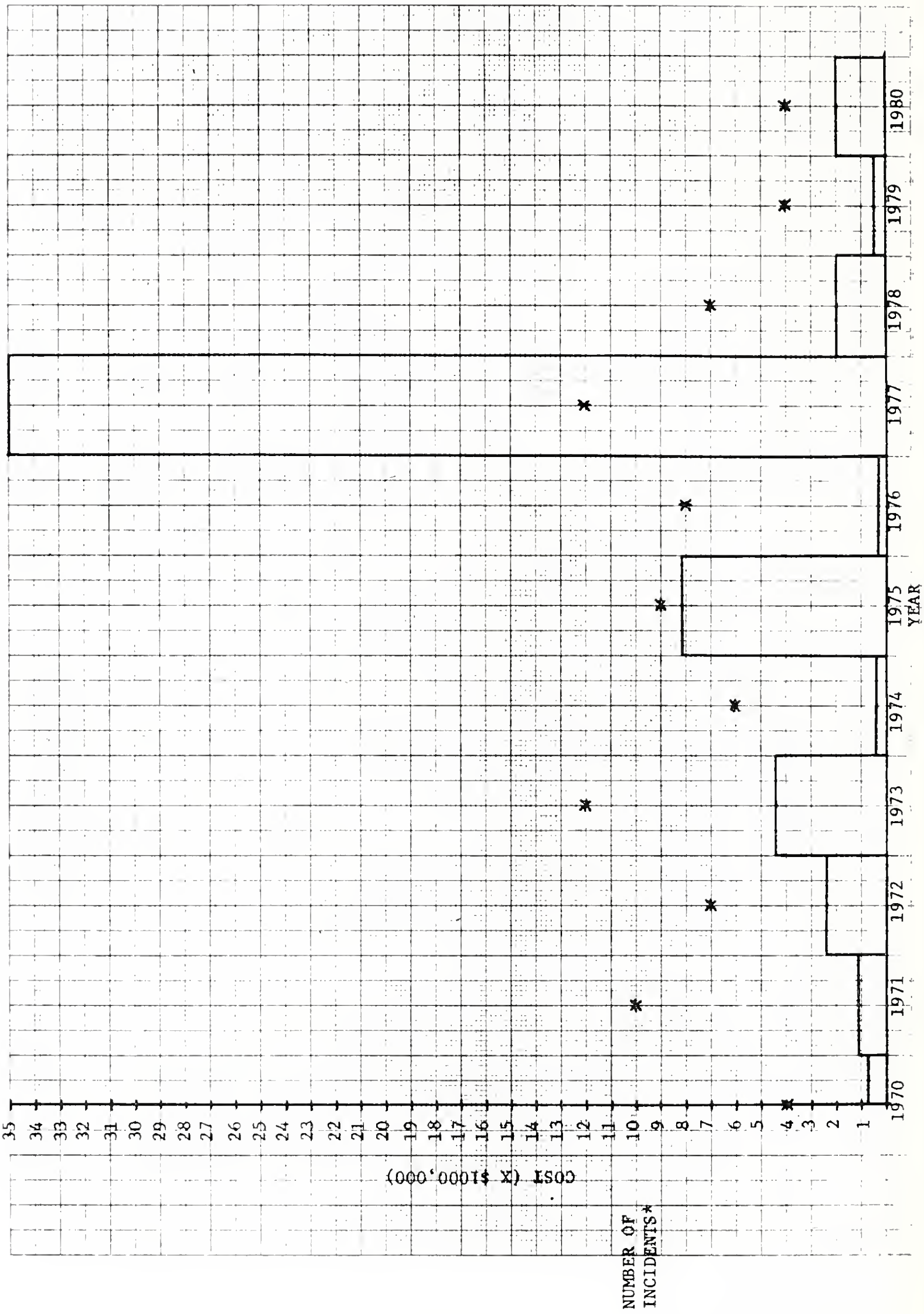
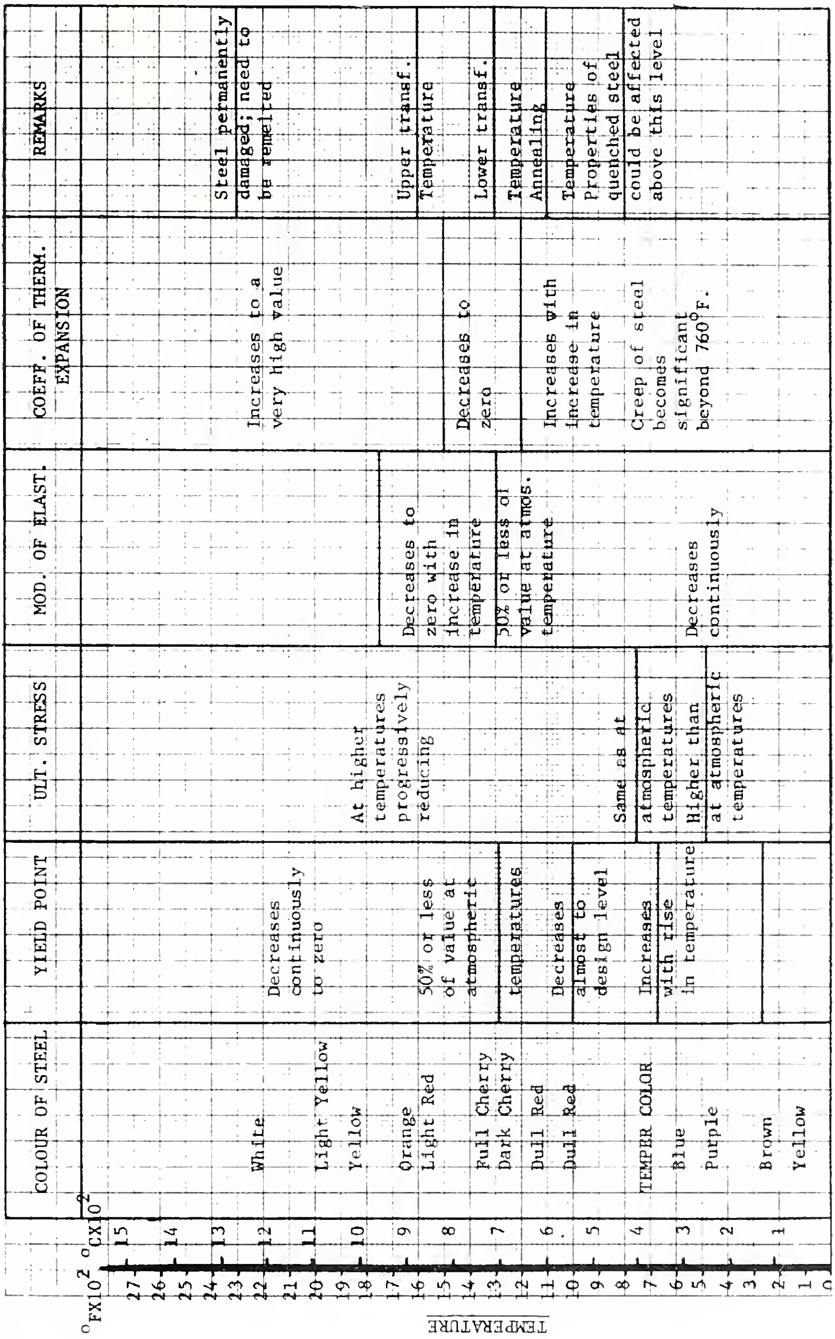


FIGURE 1

TEMPERATURE CHART OF STRUCTURAL STEEL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21
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16
15
14
13
12
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4
3
2
1
0
TEMPERATURE

°CX10²	COLOUR OF STEEL	YIELD POINT	ULT. STRESS	MOD. OF ELAST.	COEFF. OF THERM. EXPANSION	REMARKS
15						
14						
13						Steel permanently damaged; need to be remelted
12	White	Decreases continuously to zero			Increases to a very high value	
11	Light Yellow					
10	Yellow		At higher temperatures progressively reducing			
9	Orange			Decreases to zero with increase in temperature		Upper transf. Temperature
8	Light Red	50% or less of value at atmospheric temperatures			Decreases to zero	
7	Full Cherry Dark Cherry			50% or less of value at atmos. temperature		Lower transf. Temperature Annealing
6	Dull Red Dull Red	Decreases almost to design level			Increases with increase in temperature	Temperature Properties of quenched steel could be affected above this level
5			Same as at atmospheric temperatures			
4	TEMPER COLOR	Increases with rise in temperature			Creep of steel becomes significant beyond 760°F.	
3	Blue		Higher than at atmospheric temperatures	Decreases continuously		
2	Purple					
1	Brown Yellow					

FIGURE 2

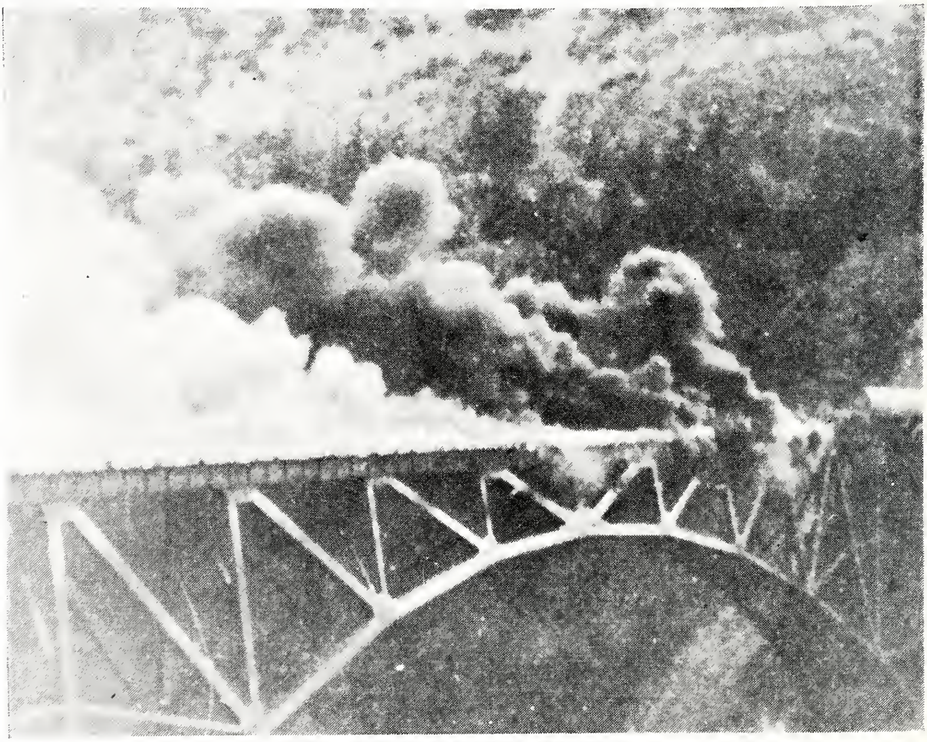
from the source of fire and the ratio of exposed area to its volume. Therefore members such as webs and bracing, etc., would be more vulnerable than flange sections. See Figure 3.

(iv) Although no correlation exists between the temperatures attained and the amount of distortion in steel, estimates of the temperatures reached during a fire are influenced by distortion and thus are often on the high side of the actuality. Temperatures of 2000°F and sometimes even higher can be attained but temperatures of 500°F to 1300°F are probably more common.

(v) Steel becomes structurally weak when subjected to high temperature. This is mainly due to its thermal and mechanical properties, i.e., coefficient of thermal expansion, yield strength, tensile strength and modulus of elasticity. Yield point decreases with an increase in temperature. Tensile strength increases a little as temperature arises to about 400°F, but it decreases and falls below the atmospheric temperature tensile strength between 600° to 700°F and then keeps on decreasing with increase in temperature. The modulus of elasticity also goes down as the temperature increases. See Figure 4.

(vi) The coefficient of thermal expansion for steel increases with an increase in temperature up to 1200°F and decreases to zero between 1200°F and 1500°F and then increases beyond 1500°F at a much greater rate. Stresses great enough to buckle the steel are developed at temperatures of only 250°F when thermal expansion is completely restrained. At higher temperatures where expansion is greater and yield is lower, even less restraint of the expansion will create sufficient stress to buckle the steel severely and permanently.

The amount of expansion at fire temperatures is high. It is an inch in each ten feet of length at 1100°F and it is



Fire often starts at one point and travels across the bridge.

TEMPERATURE CHART OF STRUCTURAL STEEL

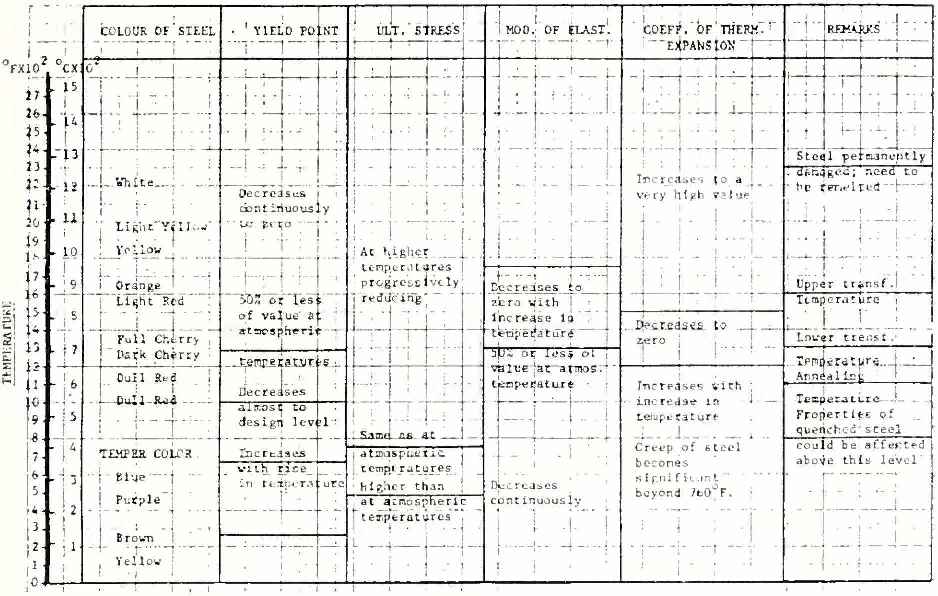


FIGURE 3

APPROXIMATE VALUES OF PROPERTIES OF ORDINARY STRUCTURAL STEEL

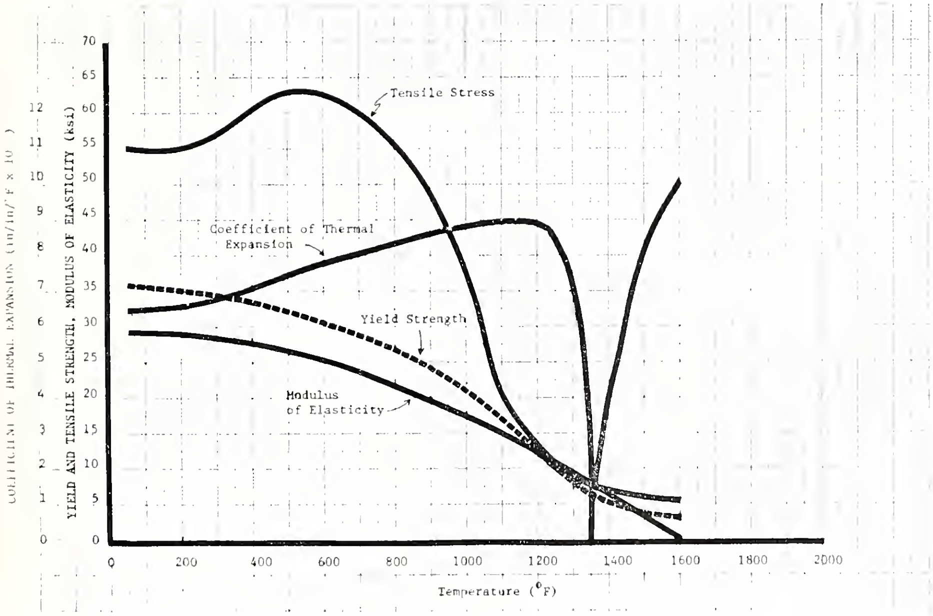


FIGURE 4

one percent of the length at a temperature of 1300°F.

Therefore a bridge member exposed to fire, owing to expansion, would initially apply considerable thrust to the connecting members. The consequence would be that if the end restraints were unyielding, the member would start buckling. However, if the ends start yielding then, in turn, this would place thrust on the connecting members, particularly the secondary ones, which may in the process be stretched to their plastic state or failure.

The connections also become overstressed and often causing rivets and bolts to be loose and crack in welds. Restraints of expansion and interaction from connected members are the more dominent causes of deformation of unloaded members. See Figures 5 and 6.

(vii) If a bridge member was large in comparison to the area under fire, such as, a deep deck plate girder or bottom chords of a truss, not every section of the member would receive a uniform exposure and thus unequal and unsymmetrical heating would take place resulting in further distortion and differential stresses in the member. A permanent deformation can be developed by temperature differentials of as little as 450°F. See Figures 7 and 8.

(viii) As mentioned earlier, heating through the transformation range (i.e., 1300° to 1550°F) could change metal-

EXPANSION AND CONTRACTION

A) UNYIELDING END CONDITIONS

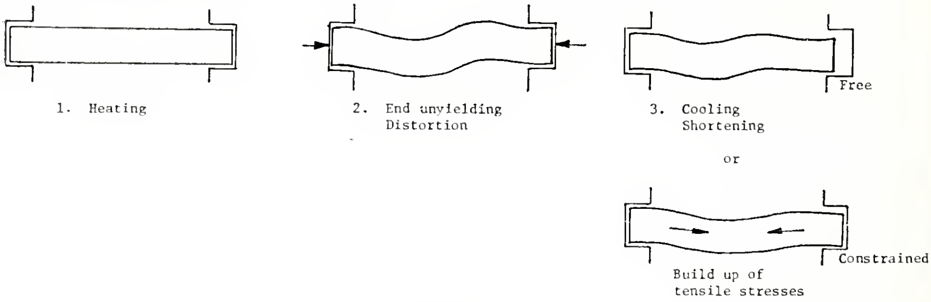


FIGURE 5

EXPANSION AND CONTRACTION

B) YIELDING END CONDITION

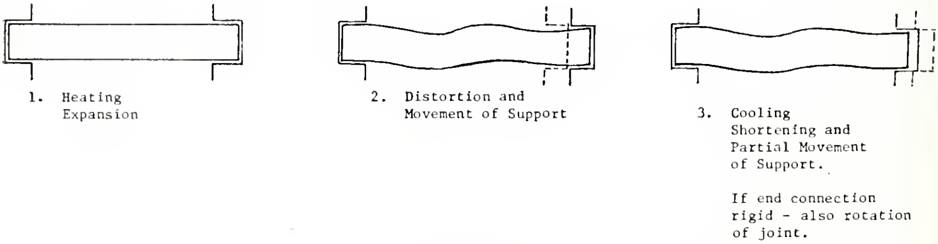
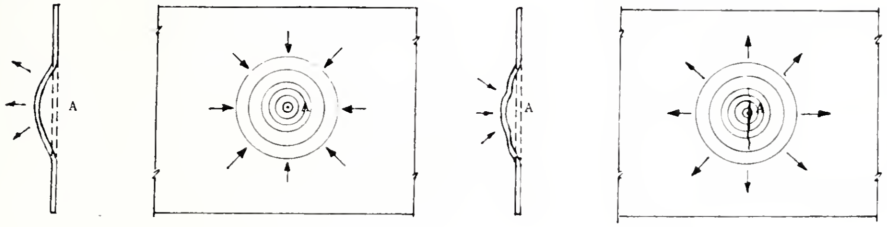

1. Heating Expansion
2. Distortion and Movement of Support
3. Cooling Shortening and Partial Movement of Support.
If end connection rigid - also rotation of joint.

FIGURE 6

LOCALIZED HEATING AND COOLING

A) THIN SECTION



Heating: Applied at A
Expansion
Compressive Stresses
Distortion

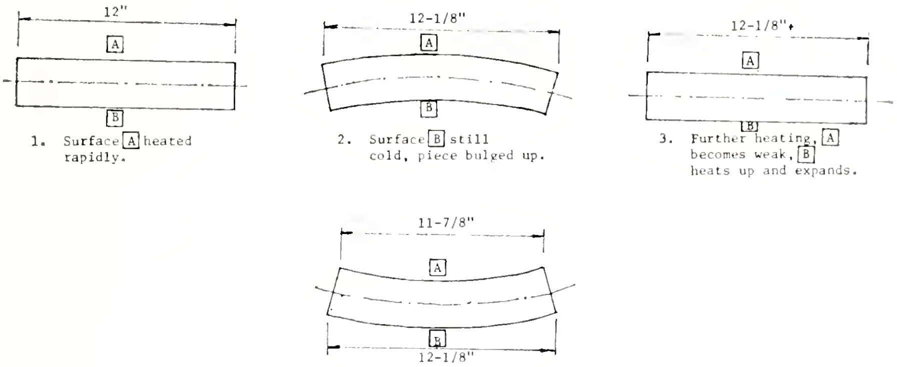
Cooling
Shrinkage
Tensile Stresses
No return to Original Form
Locked in Stress - Cracking

Example — Web

FIGURE 7

LOCALIZED HEATING AND COOLING

B) THICK SECTION



1. Surface $\boxed{A}$ heated rapidly.

2. Surface $\boxed{B}$ still cold, piece bulged up.

3. Further heating, $\boxed{A}$ becomes weak, $\boxed{B}$ heats up and expands.

4. $\boxed{A}$ goes through rapid cooling and shrinks. $\boxed{B}$ cools slowly, shrinks less, thus piece curves down.

Example — Thick Flange

FIGURE 8

---

lurgy of structural steel which, in turn, would affect the physical properties such as ductility, toughness, hardness, tensile and ultimate strengths, etc.

The properties of quenched and tempered steel may be affected at a much lower temperature.

Prolonged heating at very high temperatures, (i.e., 2000°F and above) results in development of coarse grains in steel, which are not quite detrimental in themselves, but, this phenomena is accompanied by excessive scaling and oxidation which reduces the cross-section of steel. See Figure 9.

(ix) Bridge fires are often extinguished by water. This cooling process though not as drastic as that of water quenching used in the heat treatment, could result in hardening the steel and rendering it more susceptible to brittle fracture particularly during the inclement weather.

(x) Structural steel members usually have some residual stresses in them as a result of rolling or welding operations. Subsequent heating and cooling could redistribute these stresses.

Residual stresses alone or in conjunction with the material flaws, stress raising details and changed material properties after a fire could trigger extremely high stresses with or without the presence of the live loads. These stresses may be beyond the ultimate capacity of the steel, and thus may be at a level where fatigue cracking can start and cause brittle fracture.

It is, therefore, extremely important that before any restoration work is decided upon, these stresses be carefully assessed.

(b) Areas of damage

The change in geometry of the structure should be very carefully examined. Components which have not changed their geometry and alignment and those components which have, with the degree of change, and the extent of the area should be noted. This should also include areas of localized damage on various members.

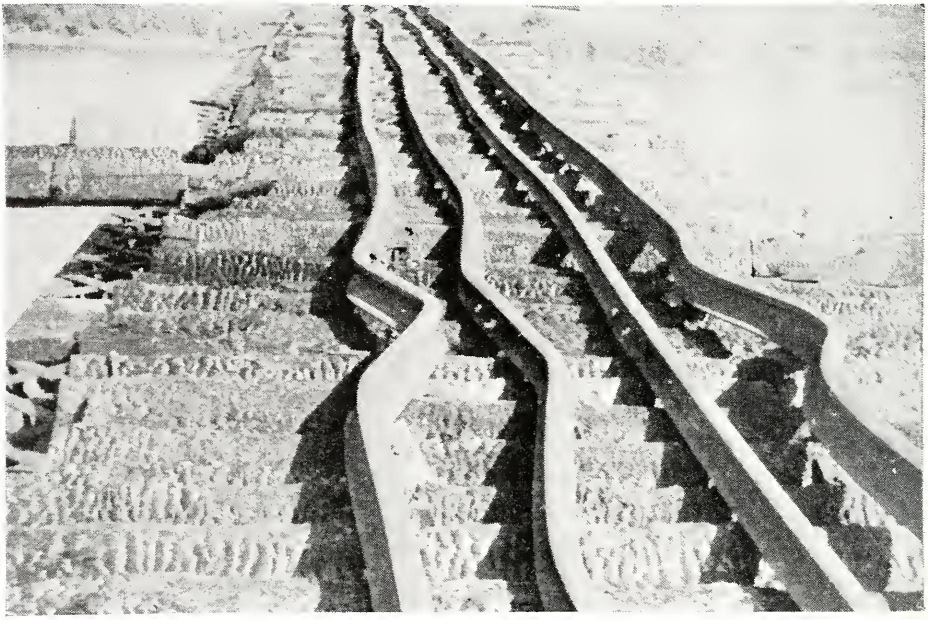
One should try to visualize the way in which the structure behaved while being heated by fire as well as when it was being cooled while the fire was extinguished.

Since on the majority of railroad bridges, fires occur in timber decks, it is necessary to examine the effect of this aspect on various types of bridge spans.

(i) Deck plate-girder span

If the girders were very shallow, the temperature across a section would be uniform and the girders would simply expand and try to shear off the anchor bolts. At the same time bracing would be pulled and being lighter might be stretched to plastic range.

The components with a smaller surface area to volume ratio such as web plates would reach higher tempera-



Change of geometry of bridge components as a result of fire.

tures, therefore, they would try to expand more. But, because the webs are constrained by the flanges and the stiffeners, they would start buckling. See Figure 10.

If the girders were deeper, the temperatures across a vertical section would not be uniform, in that the top flanges would be subject to higher temperatures than the bottom flanges. This gradient would tend to bulge the span at the initial stages, however, as the temperature rises, the temperature gradient would diminish owing to good conductivity of steel and, at the same time, the steel would lose strength and thus instead of thrusting any force, would start distorting itself. When cooling occurs, the top flange would shrink more in comparison to the bottom flange and this would cause rippling in the web.

Extinguishing of fire by means such as spray of water quenches steel; depending upon the temperatures reached, this may set up residual stresses because the components have warped, twisted, buckled and thus shortened and cannot return to their original shape. Furthermore, quenching could also cause hardness and brittleness in steel and thus steel may become more susceptible to brittle fracture.

Uneven heating could also result in loss of camber of the span, thus effecting

STRUCTURE OF IRON CONTAINING VARIOUS PERCENTAGES OF CARBON

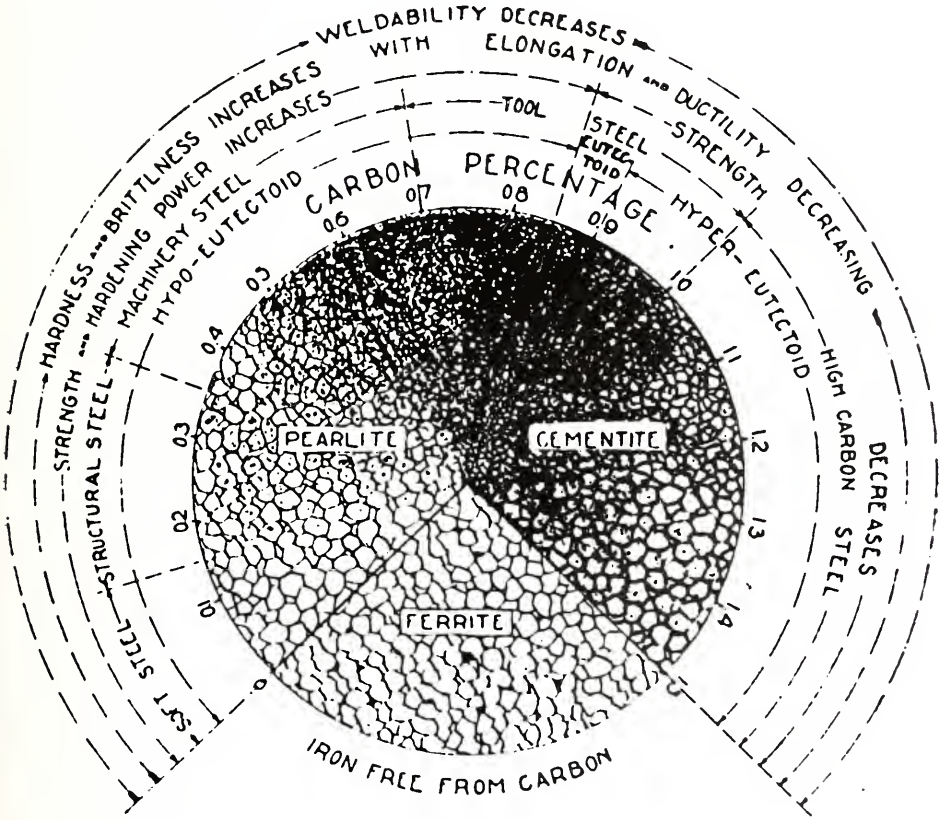


FIGURE 9

track profile.

(ii) Through plate-girder span

Since the deck in this case is supported on stringers, they would be usually the first to be affected by the fire, and would try to expand. Because their ends are connected to the floor beams, and the presence of other stringers in the same line in the adjacent panel, they would not be able to expand and would buckle.

If the fire load was high, it would also affect the main girders which would expand and pull the bracings causing them to yield or break.

The temperature rise in the main girders is usually uniform unless otherwise indicated by buckled webs.

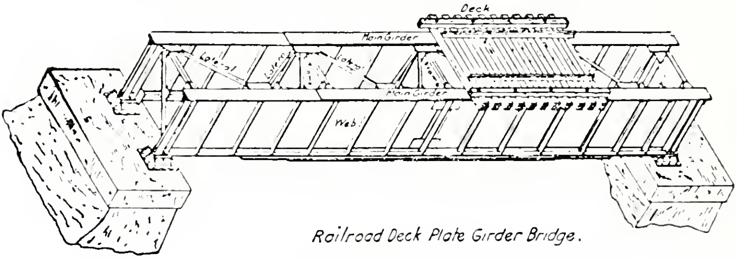
Extinguishing of fire by quenching would again set up residual stresses in the floor system as well as in the main members.

Damage to the floor system could also cause damage to main girders, particularly to the webs and the bottom flanges which are connected to floor system by means of bracings. See Figure 11.

(iii) Through-truss span

Here again, the deck is supported on stringers, so the damage to the floor system would be somewhat similar to the floor system of the Through Plate-Girder Span. However, contrary to a girder span, a truss span is a framed structure with open spaces between member components as well as between the members. This results in two things: first, a temperature gradient between the components of a member, such as inside and outside faces of a bottom

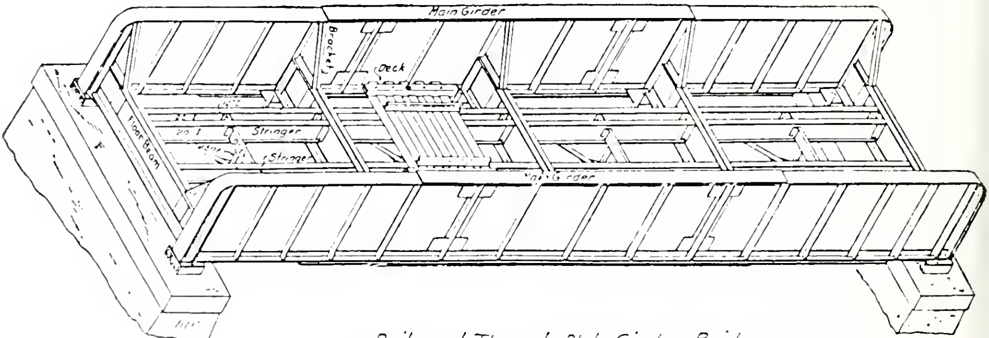
RAILROAD THROUGH TRUSS SPAN



Railroad Deck Plate Girder Bridge.

FIGURE 10

RAILROAD THROUGH TRUSS SPAN



Railroad Through Plate Girder Bridge.

FIGURE 11

chord, which would create a horizontal beam effect during the fire and second, open spaces provide more room for heat dissipation resulting in more localized heating than for other spans.

Thus, a member could suffer from local residual stresses as well as from those occurring on the entire cross-section. Furthermore, change in geometry of the bottom chord would subject the other members of the truss to stresses in a manner similar to those resulting from an initial lack of fit. See Figure 12.

(iv) Steel viaduct

If fire was on the deck of steel viaduct spans, the pattern of damage would be similar to the cases discussed above. However, if fire had started from the ground, the result could be more serious. The steel supports would become weak and buckle damaging the spans and bringing them down. A bridge with such a damage would be expensive to restore and may have to be reconstructed. See Figure 13.

(v) Other types of spans

The effect on other types of spans is usually a combination of the above-mentioned basic types. However, we should not generalize and every case should be considered individually.

(c) Concerns

The foremost concern is to restore traffic safely with minimal amount of delay and expense; then to investigate for possible repairs or replacement. Prior to restoration of traffic, emergency repairs may be necessary which should result from a through evaluation of the damage incurred.

Investigation of Damage

(a) Physical inspection

The purpose of physical inspection is to assess the temperatures attained during the fire and the extent of damages resulted from them.

Clues as to where the fire started, how it spread, how long it lasted, means of fire extinguishing, prevailing temperatures, humidity and velocity and direction of wind are useful to know in visualizing the behavior of the structure. Unfortunately the physical inspection cannot be carried out until after the fire

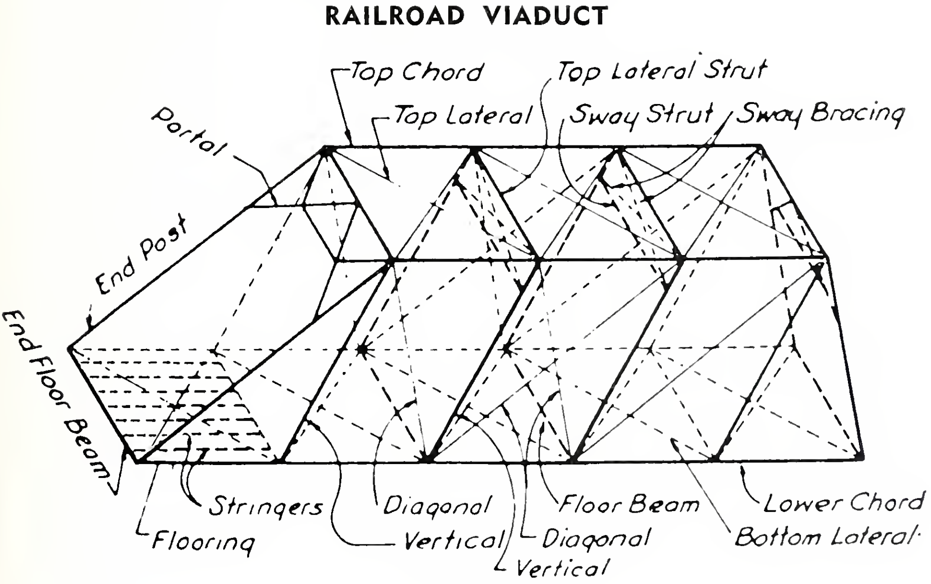
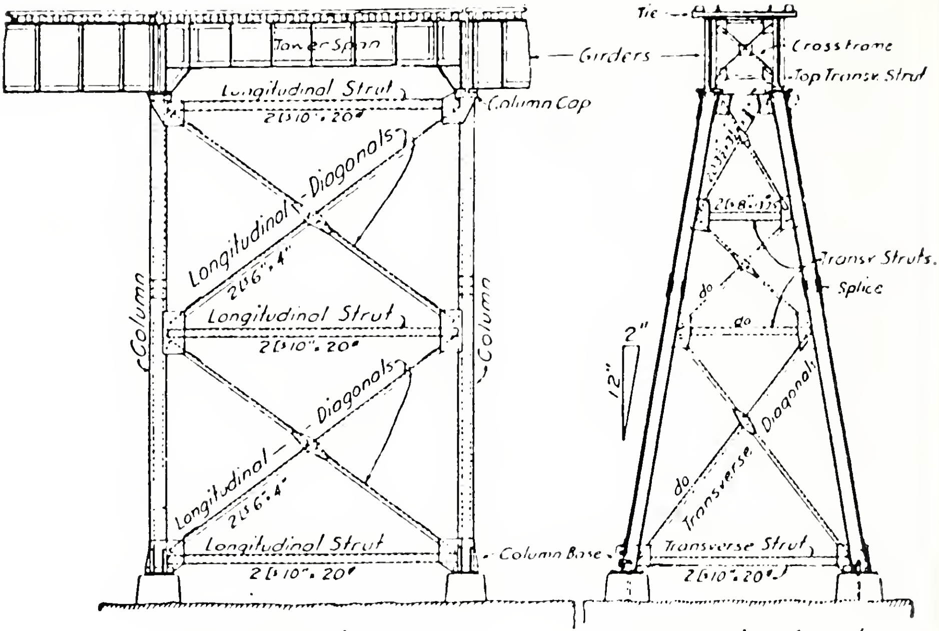


FIGURE 12



Longitudinal View of Tower

Transverse View of Bent.

FIGURE 13

has been extinguished and the steel cooled. However, prior to cleaning operation, track and deck should be examined for the nature and extent of damage, and for any material that could be salvaged for re-use on a temporary or permanent basis. It is important to record the length of damaged rail, areas of severe warping, joints failed or rail breaks and the amount of run-back in rail. Bridge deck (i.e., ties and walkway, etc.) should be thoroughly examined before it is removed for steel inspection. Note if the deck had been treated with a fire-retardant coating. If the fire stopped burning by itself, look for the probable reason for this, whether rain, an obstruction, or a complete burnout.

Before checking the steel for the following points, it is advisable to have a drawing or to prepare a line sketch of the structure so that individual components can be easily identified and properly marked. Also check the records to verify the type of steel and the pre-fire condition of the structure.

Take detailed measurements to verify alignment, levels and change in geometry of different components of the structure.

For broken members, note whether breaking resulted from tearing, yielding, buckling or cracking, etc.

For deformed members, note whether the deformation was caused by bending, twisting, buckling, warping or rippling, etc.

Also check for: loss of camber; movement of joints; sign and extent of slippage of pins and riveted connections or break at welded connections; movement and condition of the bearings and anchor bolts; condition of paint, change in color of paint or surface of the unpainted steel; movement in substructure, any cracking, breaking or impression left in masonry substructure by steel in the course of its expansion. If the substructure also has steel, repeat the above for it as well. Take photographs of all the areas affected by the fire, to substantiate your findings on the damage sustained.

The decision to carry out metallurgical investigations and measurements of residual stresses depends largely upon the findings of the physical examination. If the analysis of the physical observations reveals tolerable change in geometry, or worse if the damage is such that the structure is irreparable, then conducting further investigations would be of academic significance only.

(b) Residual stresses

If a railroad is concerned about retaining the fire-affected steel and wants thorough testing, several techniques are available for measuring the residual stresses and investigating the metallurgical changes in steel.

The various techniques can be broadly divided into two categories namely (i) destructive and (ii) semi-destructive.

(i) Destructive techniques

Cutting or releasing joints: This involves freeing the entire member by cutting or by releasing joints. Sometimes, because of the size of members or the nature of the structure, this method may not be practical.

Coupon removal technique: This involves removal of a coupon from the part under investigation. Coupon area is strain gauged and coupons are cut out either by cutting with a saw or burning with a torch. However, burning with torch itself sets up additional stress which tends to mask residual stress in the member under investigation.

Furthermore, removal of coupon necessitates considerable local reinforcement in the event it is decided to reuse the member.

(ii) Semi-destructive techniques

Mather-Socte Method or "Blind-Hole Drilling" Method: This involves the drilling of a small hole in the center of a strain gauge rosette attached to the steel. Subsequent relaxation of the strains is then measured by the strain gauge rosette. The residual stress around the hole is usually fully relaxed when the hole depth is equal to its diameter. The diameter of the hole is 0.404 inch. After drilling a hole, the blind hole is either drilled out to 1/2" diameter or removed by grinding.

(c) Assessment of damage

This involves a careful review of the physical inspection, and if required, the metallurgical investigations, the microstructure examination and the magnitude of the locked-in stresses and thereby the assessment of the post-fire capacity of the structure. This then is to be compared to the pre-fire capacity to determine the reduction in strength and particularly to identify members which are damaged but still are in acceptable condition, members which can be repaired and members which are beyond repair.

Furthermore, the money and effort involved in carrying out repairs should be compared to the replacement cost of the structure. Consideration to be given to whether the repairs could be effected under limited traffic or only under closure conditions, and what permanent damage would still remain in the structure even after repairs are done.

On a large structure, a complete inventory of the damage should be prepared to facilitate the preparation of the restoration plan.

Restoration

(a) Strategy

Restoration within the minimum amount of time is always one of the main considerations. It, therefore, often becomes necessary that the field inspection, analysis, procurement of material and mobilization of resources proceed simultaneously. Some decisions, therefore, have to be made in anticipation and under considerable pressure, which may be revised later as the restoration progresses.

Various restoration strategies which may be considered are:

I. Whether the bridge can be opened to traffic with restricted speed or load and without any emergency repairs.

II. Whether emergency repairs are necessary to restore the traffic on (i) a temporary basis pending further repairs, and, (ii) a permanent basis.

III. Whether the traffic can only be restored by (i) installation of a temporary structure, followed by repairs; (ii) replacement of the structure.

In situations where more than one option is available, a full evaluation should be made of these options, keeping in mind the time, money, availability of resources and operating conditions involved. The final decision should be based on the best compromise of these factors.

(b) Emergency repairs for traffic restoration

Each incident should be handled on an individual basis. The following may be considered as possible means of restoration.

I. Release residual stresses. This may be done by:

(i) Opening up the joints and reconnecting members with reamed holes. Replacing splice plates and angles, etc.

(ii) Straightening some members or elements by heat treatment, annealing, etc.

(iii) Peening some members or welds, etc.

II. Reinforcing to compensate for the damage.

III. Replacing damaged components.

IV. Modifying load-carrying manner of the structure by employing the above means. Examples are: addition of vertical or diagonal stiffeners to a plate girder to transform its behavior from a beam to a truss or a varendeel girder, providing additional support to a simple span to have it act as a continuous beam, etc.

V. Partial or complete replacement of the structure.

Again, each alternative should be studied, keeping in mind the extent of damage, time and money involved in the restoration process.

(c) Restoration plan for retention of structure

After a full assessment of the damage, it is essential to prepare a detailed restoration plan. A number of activities always need to be performed simultaneously, involving both other functions of the railroad as well as outside concerns and, in most of the instances, the work would have to be carried out under time restraints. A restoration plan would assist in better scheduling the various activities and orderly performance of the task.

The plan should list detail of all repair and replacement work, giving sequence of all activities with their time requirements, temporary supports where needed, material and its procurement and deployment of the work forces, and information regarding involvement and schedule of other functions and outside concerns, etc. It should also list all procedures involved, investigations to be conducted, any test train runs planned prior to opening the bridge to normal traffic.

Preventive Measures

To reduce the susceptibility of fires on steel bridges.

(a) Housekeeping—Keep the decks clear of all combustible material, and decayed spots in exposed ties or timber trimmed.

Keep brush and weeds down for a safe distance from the bridges, both underneath and on the embankment at the ends of the bridge.

(b) Careful practices—Following precautions should be observed while working on a bridge having timber deck.

Acetylene torch must be used only when doing steel repairs on a bridge and then care must be taken to prevent sparks from falling on ties or other timber. An extinguisher must always be on the site and water available to extinguish any fire started and to wet all timber subject to sparks during cutting operations. A thorough inspection to ensure that there is no fire hazard on the bridge before the work gangs leave the site.

When cutting, sawing, grinding or welding of rail is to be carried out in the vicinity of a bridge, protective shields should be used to confine the sparks.

(c) Fire protection—Application of

fire retardant castings to open decks, covering of timber deck with metal sheeting, conversion of open deck into ballast deck and installation of fire breaks, etc.

Conclusion

(i) Bridge members may undergo large deformations at temperatures which are below the transformation range where heating and cooling rates have no appreciable metallurgical effect on steel. These deformations are not in themselves evidence of steel being heated to high temperature but they are result of stress imposed on members while they were at reduced strength.

(ii) A thorough evaluation of the situation within the limits of fire damage would be a valuable investment both in time and money, in that it would not only lead to a sensible restoration plan but also would make one knowledgeable about the future expectations of the restored steel bridge.

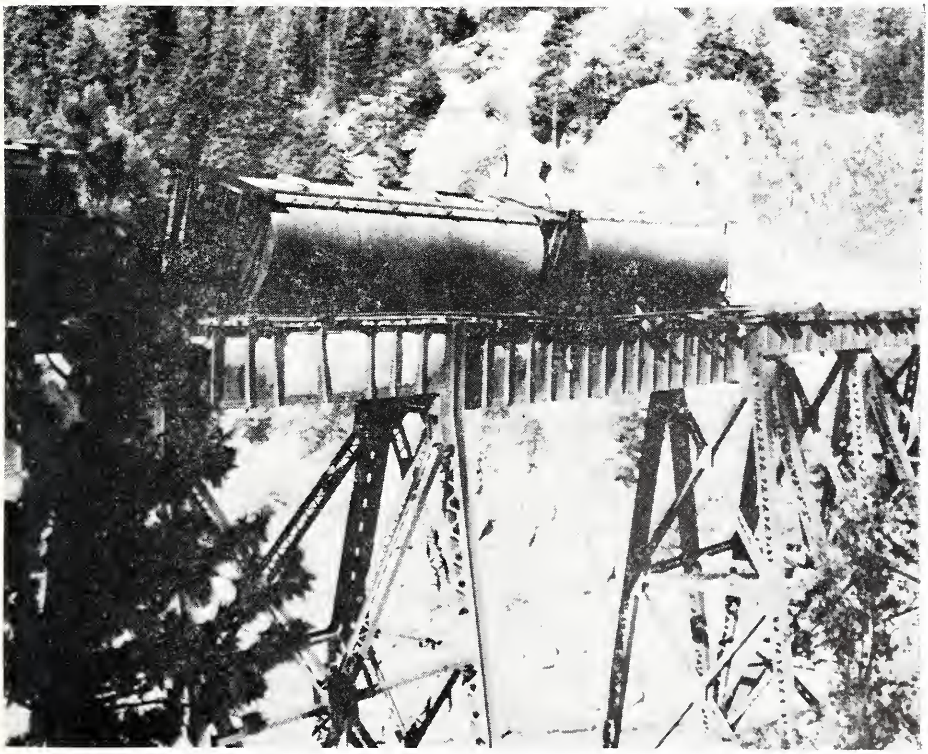
(iii) As many accidents involving fire damage to steel bridges originate from carelessness during work on the bridges, preventive measures must be reinforced such as proper housekeeping and coatings to provide early fire retardancy which enables one to extinguish fires before they get out of control.

Case Studies

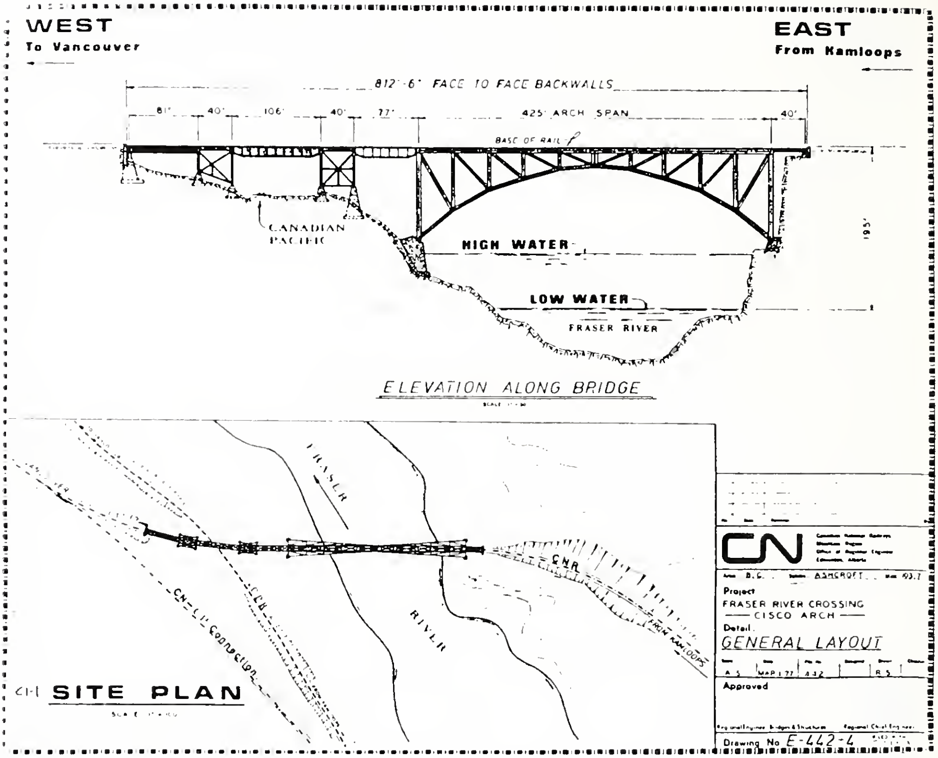
A. Cisco Arch Bridge over Fraser River near Lytton, B.C., Canada

Features: A 425 ft. long steel arch over the river. West approach consists of 5-DPG span viaduct and east approach consists of single DPG span. Timber ties up to 14″ x 22″ in size and tapered on curve to provide super elevation. See Figure 14.

Accident: August 4, 1977 at 16.08



Cisco Arch Bridge over Fraser River near Lytton, B.C., Canada



CASE STUDY "A"

FIGURE 14

hours an eastbound 82 car train of phosphate rock with four "SDP-40" units on head end derailed near the west end of the bridge. A shower of sparks both from the brakes and friction on track poured on to the now splintered ties on Span 7 meeting the fumes from creosote oil and igniting them. The ties had been coated with fire-retardant which was ripped off in the derailment.

The subsequent blaze, fanned by a very strong wind, traveled quickly across the deck of the entire structure.

Meanwhile, one part of the train was uncoupled and then dragged easterly clear of the bridge. The cars remaining on the westerly end of the bridge gradually settled into bracing between the girders as the fire consumed the ties.

Aerial water bombers were used to prevent spread of fire to surrounding forests. The fire burnt itself out by noon August 5, 1977. Ties kept on smouldering for a further 24 hours. Some charred ties remained on the arch.

Damage: The heat had caused the steel arch and girders to expand and to use up the travel at the expansion joints. Axial compressive forces had then been evidently built up resulting in lateral buckling of some girders and in cracking of the concrete abutments. Deck plate-girder spans 4 to 6 inclusive were extensively damaged. The cross-girder at the west end of the arch was bent about its weak axis. Members of the arch appeared to be straight. The webs of the arch top chord were buckled between stiffeners. The top flange of the downstream girder span No. 1 was warped for the full length of the bridge. Sway frame of girder span No. 1 were also damaged due to removal of a derailed car from the bridge.

The change of color of the primer from red lead oxide to yellow lead oxide and leaving light grey residue on the steel at the west end of the arch indicated that steel temperature had exceeded 932°F at these locations.

Residual stresses: One of the main concerns was to determine whether or not unacceptably high residual stress existed in the arch span. Two different methods of measurement were employed. The first method involved measuring the residual strains released by removal of the coupons taken from the top cover plate of the top chord of the arch. From this a residual tension of 32ksi was apparent. Consequently, a second method using the blind-hole drilling technique was employed.

In order to deal with the presence of the unacceptable residual stress, three possibilities were considered. One to release the joints of the arch in turn to relieve the stress. The second was to cancel the residual stress by the application of an eccentric force—a "post-compressioning," and the third was to remove the top cover and replace it with a new section. Under the circumstances, the third possibility was adopted and the cover plate was replaced with a new but thicker one.

Several specimens for metallurgical investigation were removed from the top flanges and webs of the main arch and following tests and investigations were carried out in the laboratory.

(a) Tensile tests from selected area (Hormsfield)
(b) Vickers hardness tests
(c) Charpy V—notch impact tests
(d) Chemical analysis
(e) Micro-examination

Although results varied somewhat, mechanical properties were of values expected for the chemical composition found. Further, there was no change in the metallurgy of steel and the microstructure showed a typical hot rolled steel of fine grained ferrite and pearlite.

Repairs: Railway bridge crews meanwhile had commenced a general cleanup and by Friday noon, work of repairs had started full-scale 24 hours a day, 7 days a week until completion.

Detail of repairs is as follows: East Abutment—repair to cracks caused by expansion of steel. Span No. 1 40 ft. girder—repair to bearings, replacement of top flange angles of north girder and top laterals and cross frames.

Span No. 2 — 25 ft. arch — replacement of top laterals, additional stiffeners, new cover plate to top lateral. Replacement of west cross-girders.

Spans Nos. 3, 4, 5 and 6 – completely replaced.

Span No. 7 – stiffeners added, straightened flange ripples and replacement of top lateral bearings.

West Abutment – cracks repaired, caused by expansion of steel. To avert future recurrence of damage from fire, the deck was converted into a ballast deck and several tower legs had to be strengthened to take the additional weight of concrete slabs and ballast.

Traffic diversion – Rail traffic was temporarily diverted over CP Rail line via easterly connection at Basque 47 miles to the east and westerly connection at 110 miles to the west of the location.

Bridge was reopened to traffic on September 24, 1977 (52 days from the time of the accident) and although traffic was resumed, a further two months work was required in completing reinforcement to some members and cleanup.

B. South Saskatchewan River Crossing, Saskatoon, Canada

Features: The bridge is 1501 ft. long and consists of 8 steel spans. At the east end, there is a 175 ft. long through truss, at the west end, there is a 50 ft. DPG span and in between there are six deck truss spans. See Figure 15.

Date of accident: August 2, 1969

Cause: Train with a car having burnt journal dragged over the bridge.

Damage: Fire started at the east end of the bridge and moved westward across the bridge.

Fire brought under control at 20:30 hours by the Saskatoon Fire Department. All rail and track material including

South Saskatchewan River Crossing, Saskatoon, Canada

guard rails were badly twisted and all ties on spans 1, 2, 3, 4, and 1/4 of span 5 amounting to 700 burnt out. Remaining 500 ties on spans 5, 6, 7 and 8 were damaged.

Thirty-one stringers on deck truss spans 2, 3 and 4 were severely damaged in that 20 had to be completely replaced and on the remaining 11, top flanges had to be renewed.

Test specimens: Fire damaged stringers were removed from the bridge. Samples of steel were cut off in pairs from the outstanding legs of the flange angles and webs. Samples were machined and tests showed that:

(i) Webs had no effects.

(ii) Flanges had increased in yield strength and correspondingly decreased in ductility due to heating and cooling but the values were still within acceptable limits.

Repairs: Removal of damaged steel was done by the railway forces whereas the erection of the replacement steel was performed by a contractor. Work was carried out around the clock. Twice, the work had to be suspended for several hours on account of the high winds. Approximately 30 stringers were replaced with new welded stringers.

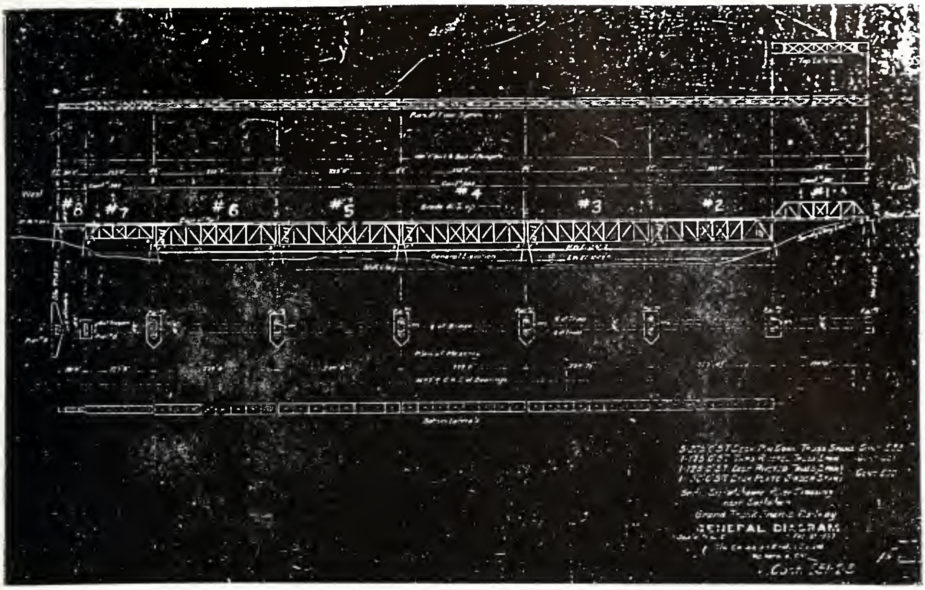
It took twenty-four days to put the bridge back in service.

C. Restigouche River Bridge Mi:
Metapedia, Quebec, Canada

Features: Five 209 ft. long skew Through Trusses over stone abutments and piers. The floor beams are below the bottom chords of the trusses. See Figure 16.

Date of Accident: March 15, 1977

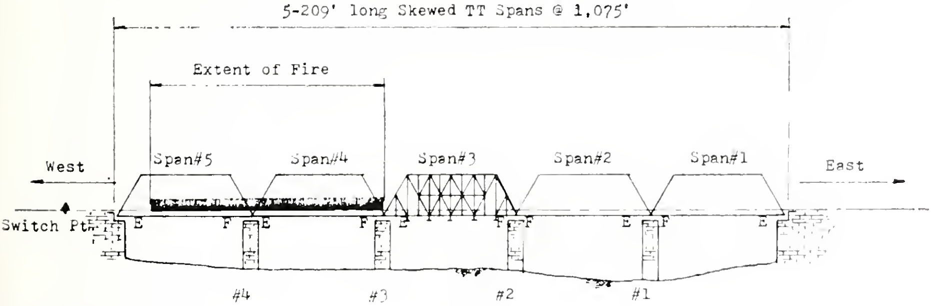
Cause of fire: B&B gang was replacing ties using torches to cut the anchor bolts—which started the fire. Buckets of water did not extinguish the fire as the existing ties were soaked in oil on account of switching operation on the bridge. The fire started at west end of span No. 3 and spread to spans Nos. 4 and 5. The B&B gang managed to cut the ties near the east end of Span #4 to stop the fire spreading to the easterly spans but were unable to carry out the same on the west end.



CASE STUDY "B"

FIGURE 15

RESTIGOUCHE RIVER BRIDGE AT METAPEDIA, QUEBEC, CANADA



CASE STUDY "C"

FIGURE 16

The Cambellton Fire Department brought the fire under control, saving approximately three bays of ties from the west end of span No. 5.

It was reported that the fire burned for about two hours.

Damage: 780 feet of rail and about 115 ties burnt on span No. 4 and No. 5. Four stringers on span No. 4 and nine stringers on Span No. 5 were badly damaged. Considerable damage was discovered in the end stringers at the west abutment and over pier No. 3 and No. 4. Some of the damage was probably caused when stringers met end on end during the fire. Truss bracing appeared to be more seriously damaged under span No. 5. Several clip angles broke while rivets were being removed. The fixed ends of spans 3, 4 and 5 had moved out of their normal positions by several inches and they kept moving further some days after the fire as well. The rollers in the expansion bearings of the three westerly spans were askew and some of them out of the bearing area. On the left truss of span 3, the outer roller was caught and jammed under the 5" projection of the fixed end of span 4 shoe plate.

In the trusses themselves the bottom chord showed evidence of fire damage. Breaks in chords and warps in members were evident. In span 4 the bottom chord had suffered local buckling of the inner bottom angle near the third panel point from the east in the right-hand truss and at the same location diagonally opposite on the left-hand truss. In both of these members the web broke under stresses induced by the fire. At almost all chord splices the angles on the inside half of the chord showed a gap of up to 1/4" while on the outside half of the chord the angles were butted. Four separate inner bottom chord members broke either right after the fire or during distressing operations when rivets were being removed (and sometimes with the stringers disconnected).

A total of six breaks was discovered in all. Two in span No. 5 involved both web plate and lower angle; one near the middle of the lefthand truss and the other near the fourth panel point (splice area) of the righthand truss east end.

Two members in span 4 had broken webs, the same inner half of the chord between the first and second splices were affected and the members were diagonally opposite in the trusses. At the easterly end of the righthand truss a single web break occurred and the westerly end of the lefthand truss three separate breaks occurred in the same member.

Metallurgical examination: Metallurgical examinations revealed that these specimens were normal A7 steel. Based on hardness and microscopic inspection there was no indication that the steel was raised to 1500°F. Brinell hardness was 130-150. Charpy unnotched test indicated a ductile material-bent with only a minor crack at a non-metallic inclusion in the specimen (120 ft.-lbs). Charpy notch test were not performed. A tension test of the material indicated 42,800 psi yield point, 65,000 psi rupture with 35% elongation. The metallurgist felt this specimen was a good A7 steel.

From this it was felt that the apparent brittleness was due to the locked-in stresses in the bottom inner half of the chord, since no rupture had occurred in the other half of the chord.

Distressing the bottom chord: Distressing was felt necessary because of the ruptures, all of which had occurred in the inside half of the chord. Also because at all inside splices there was pulling apart of the chord angles indicating a heavy overload of the splice rivets. No such distress was evident to the outside half of the chord.

The distressing of the bottom chord was carried out in the following manner. The rivets in the splices were cut out, one row at a time, and replaced with 3/4" bolts, tightened in place.

This was done for one end of each splice, inside and outside halves of the chord. The bolts on the inside splice were released and the chord permitted to slip until the shanks of the belts restrained it. The bolts were tightened, then removed one row at a time, the holes reamed for 7/8" bolts and the 3/4" bolts replaced and retightened. When the holes had thus been reamed the joint was ready to be slipped again.

The camber in spans 4 and 5 had reduced gradually to about an inch.

Repairs: Consisted of the following:

- Distressing of bottom chords of TT spans 4 and 5 and then adding plates to the web chords to compensate for any possible loss of strength.
- Undoing of stringers to floor beam connections and bracing to floor beam connections every panel-replacing the damaged stringers and their connections.
- Replacing damaged bracings.

Traffic was restored on April 3, 1977, i.e., eighteen days after the fire at 5 MPH. Remaining repairs were done under traffic.

D. The Atchison, Topeka and Santa Fe Railway Company's bridge over Trinity River at Dallas, Texas.

Features: A 198 ft. Through Truss over the river with a 184 ft. long west approach open deck pile trestle and 1402 ft. long east approach consisting of both open as well as ballast deck pile trestle. See Figure 17.

Date of accident: February 20, 1981

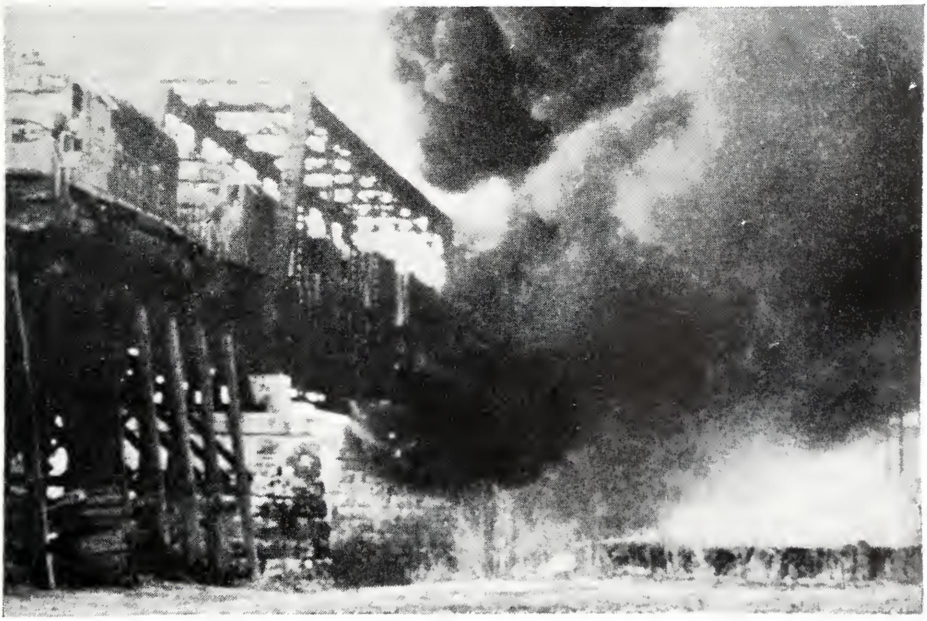
Cause: Train derailment followed by a fire on deck of the bridge near the west end of truss span.

Damage: Two of the three diesel locomotive units were removed from the bridge but the third unit and a TOFC car remained on the truss span and several cars on the trestle approach. The bridge ties under the unit and car on the truss span and the entire west approach were destroyed by fire. The unit and car on the truss dropped down on the rails and floor system of the truss when the ties were burned out from under them.

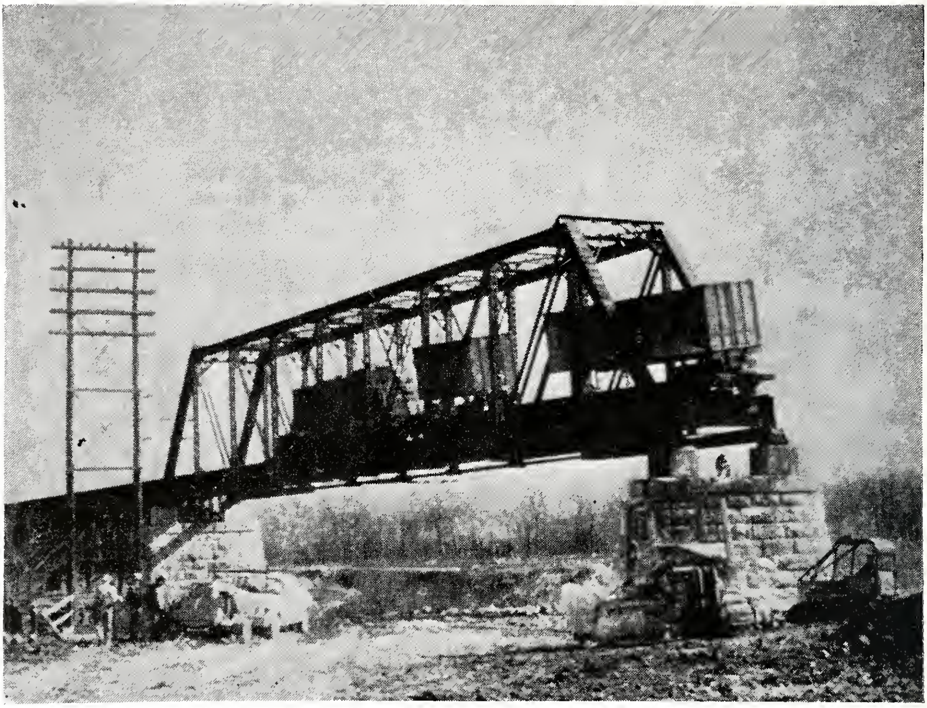
Damage to the truss consisted of severe distortion of the stringers and lower lateral system, moderate to severe distortion of the floor beams and some relaxation of diagonal eye bars in six panels of the nine-panel truss. Distortion and shrinkage of the two interior stringers in the panel under the west end of the locomotive broke all rivets through the floor beam connection at the west end of the panel. A considerable number of other rivets in the stringer to floor beam connections were broken as a result of stringer distortion and shrinkage. The west pier, which was constructed of limestone, suffered extensive spalling on the side adjacent to the trestle.

Repairs: It was necessary to restore the stringer connections before the locomotive unit could be jacked up to allow construction of a new track under the locomotive for its renewal.

Initial repairs consisted of reconstruction of the west approach using a ballast deck trestle with T-rail stringers supported on steel H-pile bents and temporary repairs to the truss. Temporary truss repairs consisted of welding a system of tranverse angles to the top



Fire in progress—The ATSF Railroad Bridge over Trinity River, Dallas, Texas



Truss, Unit and Cars after fire—The ATSF Railroad, Trinity River, Dallas, Texas

flanges of the distorted stringers to improve their capacity in compression, replacement of broken rivets with high-strength bolts and replacement of the top three rivets of the stringer-to-floor-beam connections through all floor beams where severe heating had occurred, and heat shrinking relaxed eye bars to equalize the behavior of bars in the diagonals of the truss.

Time required for the initial emergency repairs to the steel with a basic five-man steel bridge crew, assisted from time to time with additional help and supervision, was as follows:

Repairs to floor system to put into condition for jacking locomotive and fabrication of jacking supports, etc.	4 days
Jacking locomotive and constructing track under locomotive assisted by B&B gang	3 days
Welding stiffening struts to top of stringers, replacing riveted with high-strength bolts, shrinking eye bars, and installation of track panels by B&B gang	2 days
Total	9 days

Work was limited to daylighting hours with ten to twelve working hours per day.

Permanent repairs consisted of repair of the stone pier by grouting and application of pneumatically applied mortar to the spalled areas, replacement of all distorted stringers in the truss span, straightening truss floor-beams, replacing the damaged portion of the lower lateral system of the truss, and final adjustment of all eye bars in the truss. Test coupons were removed from various locations in the damaged stringers and will be subjected to both hardness and tensile tests.

Replacement stringers were fabricated with one end plain, holes to be drilled with stringers in place to allow straightening bowed floor beams to the extent possible.

Floor beams with maximum bow of 1-3/4″ straightened to within 1/4″ of straight.

E. Santa Fe Railroad Bridge over the Golden State Freeway, Los Angeles

Features: The bridge is 335 ft. long and consists of 4 double track through plate girder spans. Presently there is a track on the north side and maintenance road on the south side. See Figure 18.

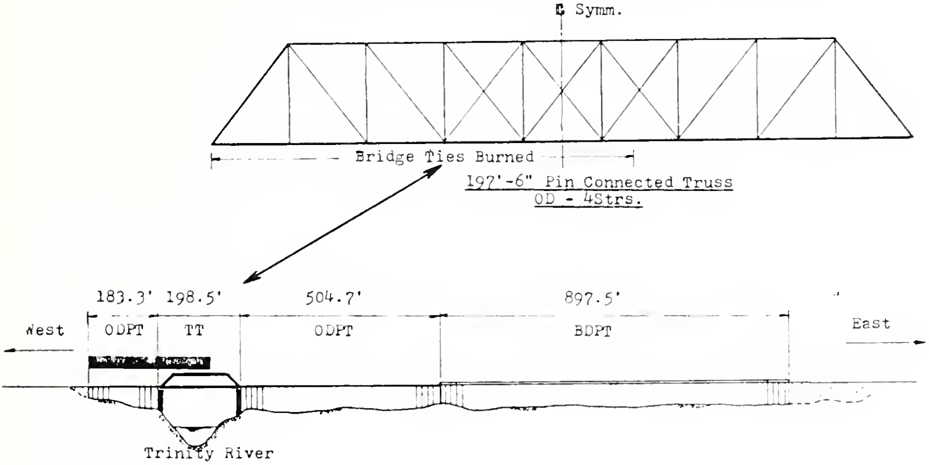
Date of accident: August 11, 1980

Cause: a gasoline tanker truck collided with a van in the northbound freeway lane adjacent to pier 2 and exploded in flames continuing to burn for almost an hour. The fire was located beneath the north girder and floorbeams at the west end of span 2.

Damage:

a) North girder span 2: At a point approximately twenty-three feet from west end, girder sagged 3 inches down and the top flange bowed two inches

THE ATCHISON, TOPEKA AND SANTA FE RAILWAY COMPANY'S BRIDGE OVER TRINITY RIVER AT DALLAS, TEXAS

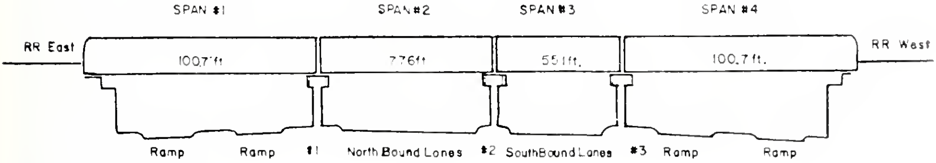


CASE STUDY "D"

FIGURE 17

SANTA FE RAILROAD BRIDGE, GOLDEN STATE FREEWAY LOS ANGELES, CALIFORNIA

Double track bridge - Maintenance Pd. on south side



CASE STUDY "E"

FIGURE 18

inward; web between stiffeners and flanges bowed inward and outward in alternate panels.

(b) Floorbeams: Steel plate deck restricted lateral movement of top flanges; bottom flanges were coped to clear the girder bottom flange and, as beams sagged up to 2-1/2″ maximum, the bottom flanges and webs warped and twisted and diaphragms buckled, floorbeam brackets remained connected to both the girder and floorbeams thus holding the girder and floorbeams in their warped and deflected position after fire was extinguished.

(c) Deck waterproofing: Three ply membrane and asphalt protective mats continued to burn and boil after the fire source was out, hot asphalt flowed into deck drains and troughs.

(d) Other: Checkered steel walk plates were warped; paint on remaining girders and floorbeams in spans 2 and 3 suffered smoke and heat damages; track, which was located on the north half of the bridge, was low over the fire-damaged area; concrete spalled back to reinforcing steel on north freestanding column in pier 2.

Repairs:

(a) Temporary:

1. A timber crib was installed under North girder at 20 ft. east of pier 2 and freeway traffic lanes were shifted to the east and a concrete barrier installed by CALTRANS personnel to protect crib area.
2. All floorbeam to girder connections were inspected for signs of distress—no rivet replacement required.
3. Track was shifted to south half of this doubletrack and rail traffic restored after work was completed.

(b) Permanent:

1. Scope: Replace north girder and twelve interior floorbeams plus steel-plate deck, channel curbs and some sections of checkered plate walkway; repair waterproofing and shift track back to original north side location on bridge. Except for a twenty-four hour period from midnight Saturday through midnight Sunday (September 13-14, 1980) all work had to be done in a manner so as to protect freeway traffic. Rail traffic was interrupted from noon Saturday through 4:00 P.M. Monday, September 13-15, 1980.
2. It was decided to replace the damaged girder with 105′6″ girder from railroad stock, modified to correct length and for floorbeam and bracket connections plus end bearing details. Twelve new replacement floorbeams were purchased from an outside supplier. All structural steel fabrication work was done at the fabricator/erectors' plant near the job site.
3. In order to be able to remove and replace the damaged girder and floorbeams within the time restraints, a considerable amount of preparatory work had to be accomplished. Also, since the freeway had to remain open except during the removal and erection work a method had to be developed to support the floorbeams for girder removal and allow for the removal and installation of replacement floorbeams before the replacement girder was erected. To accomplish this an 80 ft. "strongback" girder was installed inside the damaged girder and the floorbeams supported from its bottom flange. The floorbeams to be retained were cut loose from the damaged girder and raised as required to the proper elevation for connection to the new girder. The deck curb and diaphragm plate on the damaged portion was cut so as to form four-three beam sections and hung from the "strongback" to facilitate removal. Other preparations included cutting one of the two end connection angles through its fillet and removing rivets from the remaining angle and bracket connections and replacement of rivets with a sufficient number of high-strength bolts to support rail traffic on south side of bridge.

Track over portion of deck to be removed was stripped of ballast and set on blocking. Waterproofing repairs and painting work was accomplished after freeway and rail traffic was restored. The pier was repaired by CALTRANS after steel repairs were completed by the railroads' contractors.

Test specimens: Samples were removed from the bottom cover plate and web of the damaged girder and from the web of one of the damaged floorbeams. Lab tests revealed no thermally inducted metallurgical transformations that would adversely affect the mechanical properties of those bridge components.

President Chambers: Thank you, Mr. Lewis and Mr. Uppal. Fire damaged steel bridges can be difficult to evaluate and repairs should always be considered with a conservative attitude. It is better to repair too much than too little. A good report.

Will Mr. Kapp please come forward and take over for Standing Committee No. 2 report on "Vertical Travel Leads."

REPORT OF STANDING COMMITTEE NO. 2

Vertical Travel Leads

By ALAN G. MacKINNON and EMANUEL A. FINE

Alan G. MacKinnon

Vice President, Foundation Equipment Corp., Newcomerstown, Ohio

SEMIFIXED LEAD SYSTEMS WITH HYDRAULIC POWER BRAKE

The semi-fixed system is built around FEC's modular square tube lead. Its tetrahedral design makes it lighter and stronger than other types of lead. It has undergone extensive field testing as well as controlled static and fatigue testing. Modular in concept, lead sections and accessories feature pin-connected joints, thus permitting fast, easy building block type assembly.

Available in four sizes, the basic lead comes in 10′, 15′ and 20′ sections. Any combination of lengths can be connected to provide the required lead length. In addition, a headblock foot yoke sheave (single or double), a foot yoke with pile gate, a boom tip sled and a boom tip connector are required.

The FEC Power Brace can be used with any type lead. Hydraulically powered, the brace can be extended or retracted to achieve and hold any degree of fore and aft batter. Controls are mounted in the crane cab, thus permitting the operator to quickly and accurately position the lead.

Hydraulic System Gives Precise Control

A variable volume hydraulic system gives the operator smooth, precise control of all actions. The pump can be driven from the crane engine or an optional self-contained power unit. Other optional brace accessories include a power capstan and a side batter package. The lead is held at three (3) points: boom point, bottom brace and on the ground at the lead foot. This means plumb or batter positions can be held firmly and accurately. Sliding connections at the boom point and brace/lead point permit the lead to be lowered to rest on the ground regardless of the level of the crane. This means the pile is supported along its entire length and can be driven to cut-off grade. This feature also allows the lead to be utilized as the driving template in underwater applications.

Because the lead foot can be placed on the ground and the boom point and the brace/lead point are sliding connections, in and out batter can be accomplished by booming up or down or by extending or retracting the brace. An optional side batter package is available enabling the lead to be pivoted up to 30° either side of center. Structural rating charts are provided for each hammer, lead and crane combination. Since the lead can be raised or lowered independently as the crane boom is raised, or, lowered, the operating radius is greatly increased and more pile can be driven from a single crane position.

The semi-fixed system works as a stiff leg derrick. The only time the crane itself supports any appreciable weight is when the lead is raised off the ground for repositioning. When in driving position, the lead is on the ground, therefore, the weight of the pile may not be a consideration of crane capacity.

BERMINGHAMMER VERTICAL TRAVEL LEADS

Emanuel A. Fine

Vice President, Berminghammer Corp., Ltd., Hamilton, Ont., Can.

Emanuel A. Fine

Background

Berminghammer Corporation Limited is associated with Bermingham Construction, who have been in the pile driving and foundation contracting business since 1897. The Vertical Travel Lead system was developed in the mid 60's for crawler crane use. The system was developed by practical pile driving people in an effort to find a better way to drive piles efficiently. Although the system was originally intended for the exclusive use of the Contracting Company it was soon realized that the product had sales potential and marketing was initiated. About twelve years ago the design was refined to suit the needs of railroads with the co-operation and help of the C.N.

Those of you who have been close to pile driving realize that on a typical piling job the actual hammer time might amount to two or three hours of an eight hour shift. Thus, an efficient lead system can have much more significance on production than one hammer versus another.

The first Vertical Travel Leads fitted to Locomotive Cranes were retro-fitted to existing cranes at our Hamilton, Ontario plant. At a later stage we undertook retrofits in the field. When the need to fit the equipment to new cranes first arose, it was done for Canadian railroads and we continued to modify new cranes at our Hamilton, Ontario premises, following delivery by the crane manufacturer.

Eventually, we made arrangements to install the hydraulics package for new cranes at the crane manufacturer's factory. This made it feasible to properly service the U.S. market for pile driving attachments for new cranes. As will be seen from the slides, we have furnished a substantial number of rigs to Canadian and U.S. railroads.

The tie-in with a construction company give us the advantage of being able to continuously use, test and improve on the equipment. We welcome feedback from our customers and try to incorporate their suggestions for improvements, with a view to providing the most versatile, flexible, high speed and rugged equipment available. We believe it to be the last word in pile driving equipment.

Berminghammer has fitted leads to American, Wellman, Dominion and Ohio locomotive cranes, diesel-electrics, diesel-hydraulic and diesel-electric hydraulics. We have retro-fitted cranes previously used with older more clumsy lead systems and cranes never previously used for pile driving, as well as new rigs. Our railway users include Canadian National, Canadian Pacific, Northern Alberta Railway, Burlington Northern, Atchison Topeka and Santa Fe, Southern Pacific Transportation Company and Denver, Rio Grande Western. The leads, though intended for Berminghammer diesel pile hammers, will accommodate other hammers. Conversions of hammers built for box-type lead have been carried out for various users.

Components Likened to Parts Of Human Body

The principal components of the vertical travel lead system can be likened to parts of the human body:

> The heart of the system is the hydraulic pump which supplies the operating fluid stored in a hydraulic reservoir and circulated through hydraulic lines analogous to arteries and veins. The "muscles" are the hydraulic cylinders which provide the in and out and sideway movements of the kicker, which provides forward batter and side batter and the hydraulic winches which raise the kicker and provide the vertical travel movement of the leads. The hydraulic control levers mounted in the crane cab can be likened to the "brains" of the system and the lead column can be considered the "spine."

The controls consist of a three bank hydraulic valve which controls the kicker movements—up and down, in and out and right and left. Another single valve controls up and down movement of the lead column itself.

The most common railway crane application involves the use of a 40 ton to 60 ton crane with a 50 to 55 ft. boom and a 70 ft. length lead column with a kicker (or bottom brace) with a retracted length ranging from 18 ft. to 21 ft., depending on crane capacity. This provides a variable range of reach. In conjunction with crane boom angle adjustment the kicker is extended or retracted to adjust the reach. To accomplish extremely close reaches the kicker is retracted and raised hydraulically. The hydraulic winch line to the lower side on the front of the kicker is connected through a spring loaded safety stop which automatically locks the kicker to the lead, preventing dropping the kicker in the event that the kicker hoist line breaks or tension on this line is lost for any reason. The maximum reach, with kicker fully extended is controlled by the kicker model provided which must be limited by crane capacity, but the trestle bent centres of up to 32 feet can be provided. The kicker also serves as an access walkway to the lead column, with a non-slip mesh surface and a telescoping safety handrail.

Forward and aft batters of up to 1 in 3 can be accomplished, at various distances from the crane.

The kicker has a 36 degree maximum side swing angle which makes it possible to accomplish 1 in 4 side batter at most radius and up to 1 in 3 at extended radius. In side batter a hydraulic self-contained slave system automatically supports the leads against twisting. The side batter adjustments also provides a ready means of plumbing the leads when the crane is on track which is super elevated.

Compound or skew batters, which are combinations of side batter are forward, or aft, are also readily accomplished.

The entire lead column is independently raised or lowered on a hydraulic winch. This movement has numerous advantages. It permits driving of longer piles, by raising the leads initially and lowering them as driving proceeds. It allows the lead base to be adjusted to track level regardless of boom angle. It allows the lead to be lowered below track level to guide the hammer to pile top level where cut-off is below track level. It allows the lead to be raised to clear obstructions such as driven piles not yet cut-off or to drive piles on high banks alongside the track without "grounding" the leads. It allows the leads to be raised so that hammers may be mounted without unbolting lead guides by feeding the leads down through the hammer guides.

Berminghammer advocate picking up and spotting piles by hoisting the pile by a pick-up point some distance below the top of the pile, dragging it up to the leads with the pile line, inserting the top of the pile in the hammer drive cap, then raising the pile and hammer together at the same time, until the base of the pile clears the ground, then penduluming the pile into the lead and closing the pile gate around the pile. This is best accomplished with the leads on a very slight aft batter. The hammer drive cap and pile gate lock the pile in, parallel to the lead. The pile radius and batter are then set with the controls and the pile spotted in position and driving is commenced.

Leads Act As Boom

Berminghammer has designed their leads so that the lead extension above the boom point can act as a boom for the lifting of loads up to four tons. The top of the leads effectively act as a telescopic boom extension or jib. This permits unloading and handling of materials without unrigging of the leads.

The leads can be folded down rapidly with the base of the leads supported in a travel box on the front of the car body. Fold-down can be accomplished in less than two minutes with all operations controlled by the crane operator. The overall height in the fold-down configuration in fourteen feet or less. The boom, kicker, leads and hammer form a "sandwich," all approximately parallel to one another. Clearing of track to other traffic, travel about the job site and between sites at reasonable distances can be accomplished in this configuration. It is also possible to fold-down onto a lead storage car coupled to the crane for longer distance moves. Berminghammer have furnished lead storage cars for storage of leads, hammer and accessories for transportation in train, permitting very rapid rig-ups. Some railroads have even more sophisticated storage cars which store the boom over top of the leads.

Berminghammer is prepared to incorporate special features in their leads where required by the user, such as remotely controlled hammer rests.

Berminghammer is constantly developing methods to facilitate railway trestle piling work. One recent development is a swivel pile gate which allows a square section pile such as an H pile to be rotated about its own axis to permit the faces of all the piles in the trestle to be aligned, holding the pile in the proper orientation for driving.

Berminghammer has the know-how and are interested in working with their customers to solve their special problems in the most efficient manner possible.

President Chambers: Thank you, Mr. Kapp, Mr. MacKinnon, Mr. Fine, and others.

Equipment for driving piling is the name of the game to many in the B. & B. departments. New and innovative equipment that will do the job more efficiently is very welcome. Another report that meets the goals of the Association as a clearing house.

This concludes today's program.

The REMSA Banquet is tonight. It is sure to be of very high quality as REMSA banquets always are.

There will be door prizes tomorrow.

Meeting is adjourned.

WEDNESDAY MORNING

SEPTEMBER 16, 1981

President Chambers: The meeting will come to order. Please close the doors.

— Pause —

Good morning, members and guests. Welcome to the final session of our 86th Annual Conference.

Will the officers and directors please come forward and be seated.

The total registration is 759. One hundred thirty-seven ladies are registered.

Our business session will begin. The reports presented to you provide information concerning the affairs of our Association. If you have any questions regarding a specific report, please wait until all reports have been presented at which time we will attempt to answer your questions.

Our secretary, Mrs. Pat Weissmann will present the secretary's report.

Secretary's Report

Report of Membership for Period September 1, 1980 to August 31, 1981

ACTIVE MEMBERS			
Total Active Members—September 1, 1980		411	
New Active Members since September 1, 1980		49	
Reinstated—paid back dues		6	
			466
LESS: Resigned	12		
Transferred to Life	6		
Deceased	1		
Dropped for non-payment of dues	14		
Adjustment of count (duplicate cards)	1	34	
TOTAL ACTIVE MEMBERS			432
ASSOCIATE MEMBERS			
Total Associate Members—September 1, 1980		85	
New Associate Members since September 1, 1980		15	

		100	
LESS: Resigned	3		
Dropped for non-payment of dues	3	6	
TOTAL ASSOCIATE MEMBERS			94

LIFE MEMBERS

Total Life Members—September 1, 1980		146	
Transferred from Active		6	
		152	
LESS: Deceased	3		
Dropped by request	1	4	
TOTAL LIFE MEMBERS			148

HONORARY MEMBERS

Total Honorary Members—September 1, 1980		10	
LESS: Reported deceased	1	1	
TOTAL HONORARY MEMBERS			9
TOTAL MEMBERSHIP — ALL CLASSES — AUGUST 31, 1981			683

LAST YEAR:

Active	411
Associate	85
Life	146
Honorary	10
	652

President Chambers: Thank you, Mrs. Weissmann. Mr. Armstrong will present the Treasurer's report.

Treasurer's Report

September 1, 1980 to August 31, 1981

Checking account balance, August 31, 1980		$ 357.69

RECEIPTS

Dues	$ 3,633.00	
1979 Advertising	14,041.91	
1980 Advertising	1,745.00	
Transfer of funds — Homewood Federal S&L	8,845.50	
Interest on checking account	66.83	28,332.24
		$ 28,689.93

DISBURSEMENTS

Salaries (Secretary & Assistant)	$ 5,545.40	
FICA (on payroll)	358.88	

Federal Unemployment Tax	20.40	
State of Illinois — Unemployment Tax	12.77	
Office rent, telephone, etc.	543.57	
Postage	566.39	
Office supplies	243.93	
1979 Advertising (American Publishing Co.)	5,831.82	
1980 Advertising (American Publishing Co.)	713.00	
Membership certificates	79.20	
1980 Conference expense	1,776.79	
1981 Conference expense	135.92	
1979 Proceedings	6,015.93	
1980 Proceedings	2,211.56	
Executive Board Meetings	657.53	
Brief cases	268.08	
Printing and stationery	475.91	
Contributions	300.00	
Miscellaneous	344.27	26,101.35
CHECKING ACCOUNT BALANCE, August 31, 1981		$ 2,558.58

Balance August 31, 1980—$8,861.45

President Chambers: Thank you, Mr. Armstrong. Will Mr. Iwinski please present the report of the Auditing Committee.

Report of Auditing Committee

September 3, 1981

TO: MEMBERS OF THE AMERICAN RAILWAY
BRIDGE AND BUILDING ASSOCIATION

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period from September 1, 1980 to August 31, 1981, inclusive, and have found them to be correct as of August 31, 1981.

Respectfully submitted,
J. R. Iwinski, Chairman
J. R. Williams
H. M. Wilson

President Chambers: Thank you, Mr. Iwinski. You have heard the reports of the Secretary, Auditing Committee and Treasurer. Does anyone have any question or discussion regarding these reports? If not, I will entertain a motion that these reports be accepted as presented.

After motion and second.

President Chambers: It has been moved and seconded that the reports of the Secretary, Treasurer and Auditing Committee be accepted as presented. All in favor signify by saying aye (pause)—opposed nay (pause). The motion is carried and the reports are accepted as presented.

Mr. C. M. Russell, Chairman of the Resolutions Committee will give his report.

Report of Resolution Committee

MR. PRESIDENT, as a token of appreciation for the time and effort certain individuals and organizations have contributed to make this, the 86th meeting in the 91st year of the American Railway Bridge and Building Association an outstanding success, the Resolutions Committee presents the following resolutions:

BE IT HEREBY RESOLVED that the thanks of the Association be extended to Reverend LeRoy Cronkhite II, Pastor, Central Church, Chicago, who was so kind to come among us and invoke the blessing for spiritual assurance.

BE IT FURTHER RESOLVED that the thanks of the Association be expressed to the prominent speakers who gave of their time and so capably shared their knowledge and counsel with us, especially . . . . . AREA president, W. Glavin; REMSA's president, Cal Coy and first vice president W. J. Gallagher, president Larry Cena of the Santa Fe; William H. Dempsey, president and chief executive officer of the AAR; J. W. Gessner, president of the Missouri Pacific; Konrad Naue of the German Federal Railroads, Munich, Germany; George Gearhart, general manager safety, Norfolk & Western; J. R. Donahue, assistant chief engineer-design and construction, Long Island RR; Peter Conlon of the AAR; H. I. Hayes, chief overhead catenary systems engineer, International Engineering Company; A. M. Zarembski, manager track research division, AAR.

BE IT FURTHER RESOLVED that our thanks be expressed to Mrs. W. R. Hyma and her committee for their efforts in arranging registration and entertainment for our wives and to the untiring efforts of the ladies who assisted with registration.

BE IT FURTHER RESOLVED that a special thanks be expressed to our retiring secretary, Ann Wilson, who for the past eleven years has so cheerfully and efficiently handled our many activities. We wish her and her husband, Dick, the best and many happy years of retirement.

AND BE IT FINALLY RESOLVED THAT THE Association expresses its thanks to its chairmen and their committees for their work in preparing the reports which were presented at the meeting, also to the railway companies who provided assistance at the registration desk; to REMSA and all its members for the fine banquet we enjoyed last evening and as well as to the members of our executive committee and to our President, Mr. J. W. Chambers, who has spent so much of his own time and effort in guiding the affairs of our Association over the past year.

MR. PRESIDENT, we recommend these resolutions be made a part of the official record of this Association and that copies be presented to all concerned parties.

Respectfully submitted,

C. M. Russell, Chairman
Resolutions Committee

President Chambers: Thank you, Mr. Russell. Mr. O. D. Anthony, Chairman of the Necrology Committee will now present his report.

Report of Necrology Committee

1980 - 1981

To the President and Members of the

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION:

It is with grief and regret that we report the known loss of five (5) members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of any, please report their names to the Secretary. The following have been reported since our last Annual Conference in September 1980.

Active Member	Title-Railroad-Location	Joined	Deceased
M. Schifalacqua	B.&B. Engineer ConRail Philadelphia, Pa.	1970	1981
Honorary Member			
H. D. Curie	Master Carpenter Baltimore & Ohio R.R. Garrett, Ind.	1942	1980
Life Members			
A. A. Colvin	Division Engineer C.&N.W. Trans. Co. Wheaton, Ill.	1937	1980
B. O. Johnson	Office Engineer C.M.S.P.&P.R.R. Chicago, Ill.	1931	1975
E. B. Tourtellotte	Asst. Division Engineer Boston & Maine Corp. Greenfield, Mass.	1947	1981

Respectfully submitted,
O. D. Anthony, Chairman

President Chambers: Thank you, Mr. Anthony. Let us stand for a moment of silence in remembrance of these members.

Will Mr. Denz introduce the first speaker of the morning on "Renewing Caps on Ballast Deck Bridges"? I would like to see all the chairmen introduce any members of his committee that are present.

Renewing Caps on Ballast Deck Bridges

COMMITTEE—R. A. TALLENT, JR., *Chairman*, Proc. Engr. Struct., Southern, Atlanta, GA; N. D. BRYANT, *Vice-Chairman*, Sr. Br. Engr., BN, Springfield, MO; J. C. CALHOUN, Gen. B&B Supv., Southern, Chattanooga, TN; J. W. DEVALLE, (Ret.) Chf. Engr. Br., Southern, Marietta, GA; A. S. UPPAL, Engr. B&S Mtce., CN, Montreal, Quebec.

R. A. Tallent, Jr.

The big question among railroads today is what to do about decayed timber ballast deck caps. Replacement of ballast deck caps is a time-consuming and costly job even when timber is used to replace timber. Some railroads simply wait until a good number of caps and stringers go bad before removing defective timber and replacing them with new timber caps and stringers. Double capping is often necessary in order to reduce the ballast load. Some railroads respond to ballast deck renewal by replacing the cap with timber cap that is either roped in by hand, or by using a small hoist or crane.

The question I wish to pose is, "Can we afford such methods?" "Can we also afford to keep replacing timber caps with timber caps?"

Many railroads believe we cannot keep replacing timber with timber. Many railroads are replacing timber caps with concrete caps. Advantages and disadvantages are found in using concrete to replace timber.

Advantages:

1. Longevity of concrete cannot be questioned. We do not know how long a concrete cap will last, but we do know that it will last longer than the timber cap.
2. With a concrete cap, loads are more uniformly distributed over the pile.
3. Concrete caps can withstand much higher compression loadings.
4. The initial cost of concrete caps versus timber caps is negligible.

Disadvantages:

1. The concrete cap is larger than the timber cap being replaced and a good pile cut-off must be achieved. This cutoff can take many precious minutes because drift pins in the pile are driven into the piling and then a near perfect pile cutoff has to be made.
2. The second disadvantage of concrete versus timber is the weight factor. Concrete caps weigh more than three times the weight of timber. This weight prevents us from roping in or using some of the many light hoists that we used in the past to handle timber caps.

Advantages Outweigh Disadvantages

The advantages of concrete versus timber far outweigh the disadvantages if the proper equipment and methods are followed.

For the next few minutes, I will share

with you some of the ways that some railroads have approached the concrete cap renewal problem and I welcome your comments and questions during and after my presentation. Who knows, maybe through sharing ideas some of us may leave this conference with a better idea on ballast deck cap removal.

Renewal of timber ballast deck caps with concrete requires a commitment from the railroad to buy the equipment needed to get production up to acceptable levels.

As I just stated, the key to renewal of timber caps with concrete is proper equipment. Mr. Tallent showed slides of the equipment used by one railroad in ballast deck cap renewal.

1. A crane or hoisting equipment is necessary. In this slide he showed a 12.5 ton rough terrain crane equipped with high rail gear.
2. Hydraulic power pack — these units can be purchased from various suppliers. This particular unit he showed was powered by a Deutz 3 cyl. diesel engine with 3 hydraulic pumps at 14 gallons per minute at 3500 p.s.i.
3. Hydraulic jacks are powered from hydraulic power pack. The jacks shown were 42 ton capacity with 17" stroke and operate at 3000 p.s.i.
4. Hydraulic hand tools — hacksaw, drill, impact wrench, chain saw and punch are all powered off the hydraulic power pack at 2000 p.s.i.
5. Scaffoldings, cable slings, and chokers are used in lifting the concrete and timber caps.

Steps of the Operation

I would like to go through a step-by-step operation showing the use of the above-mentioned equipment in the removal of a timber cap and replacing it with a concrete cap.

With the use of two heavy duty push cars, all of the above-mentioned equipment is loaded along with six caps for transportation behind the rough terrain crane to the work site. The loading of all the material and equipment on the push cars took 38 minutes. Once the material and equipment reach the trestle, everything is unloaded and the only thing brought back to the crossing are the old timber caps. Each morning additional caps can be carried to the trestle as needed.

The steel header with jacks attached is swung under the trestle with the use of the rough terrain crane. The header and jacks are tied off to the trestle and the scaffolds are put in place. The steel fulcrum blocks are chained to the piling with 5/8" registered chain. The jacks are rolled in place and set on the fulcrum blocks. The hydraulic hoses are attached from the four jacks to the hydraulic power pack and with the movement of one lever on the power pack, the trestle is jacked up. The jacks are 42 tons with 17" stroke, but a lift only two to three inches is needed for cap renewal.

The drift pins are now cut out between the stringer and cap and between the cap and pile. The drift pins are cut with a hydraulic hack saw. This hydraulic saw works off the tool hook up on the hydraulic power pack at 2000 p.s.i. Most railroads have instructions against using oxygen acetylene torches to cut bolts and drifts on timber trestles, therefore, the most effective means of cutting drifts on ballast deck trestles is the use of a hydraulic hack saw. Cutting time for a 3/4" drift depends on the hardness of the drift and the condition of the saw blade can range between 5 to 90 seconds.

After the drift pins have been cut, the trestle is jacked a little higher to prevent the drift pins from hanging on each other while the old cap is being removed. Removal of the timber cap is accomplished by use of a loop cable, which is looped around one end of the cap. The loop cable is then pulled under the trestle and up the outside stringer on the opposite side. The loop cable is then attached to the hoist line and using the outside stringers as a guide, the old cap is pulled about 60% out from under the trestle. A choker is placed around the cap and it is removed.

The cutoff drift pins are now pushed

down into the piling by a small hydraulic cylinder with a punch welded on the end. The drift pins are pushed approximately 3″ into the piling so that the chain saw blade will pass over the drift pins when making a cutoff on the piling.

The concrete cap is deeper than a timber cap, therefore, a portion of the pile has to be cut off to make room for the cap. The cut off is one of the most critical parts of the operation. Without a level cut off, your concrete cap will not seat properly, causing a flexing action in the cap.

To help alleviate this problem, a combination straight edge and saw guide has been put together in such a way that when the guide is set up level, no mistakes can be made in the proper cutoff.

The guide unit is constructed of three inch channel iron with 3/8″ heavy wall steel pipe welded to the top outstanding leg of the channel. A 1/2″ heavy wall pipe is then slotted longitudinally in order for the 1/2″ pipe to slide over the 3/8″ pipe. The saw glide is then welded to the 1/2″ pipe. A hole is drilled in the end of the saw blade and the saw guide. A 1/2″ cable is run to the far end of the saw guide and hooked into a 1500 lb. handcrank. The other end of the bar is slotted 18″ to the blade. That slot fits into the saw guide on the opposite side of the bent. As you cut the pile, you hand crank the saw on the straight line and have a perfect cut off. Using the saw guide system we can make a cut off on ten bents before the saw becomes excessively dull.

Once the cutoff has been made and the straight edge removed, the concrete cap, with the use of the hoist is placed about halfway under the trestle, the loop cable is now used in the reverse manner, as described above to pull the new cap in place. The cap is centered on the bent and the jacks are released, lowering the stringers on to the new concrete cap. The jacks and header are removed and placed along side the next cap to be replaced.

With the cap in place, 21″ drift pins are placed in the holes in the bottom of the cap and driven in to the stringers. Pile straps are bolted in place through the holes in the side of the concrete cap and attached to the piling.

Four pile straps are used per cap. Angles are bolted to the cap and the outside ballast stringer. This, along with the drift pins, prevents the stringers from moving laterally and causing ballast leaks.

The bolting and drilling required to attach pile straps, angles and bracing is accomplished by using the one inch drive hydraulic impact wrench and the hydraulic drill.

The total time elapsed for the ballast deck cap replacement was from one and one-half to two hours. This is about one-third to one-fourth time taken in the past to replace a cap.

I now have a film showing the same process I just went through with the slides after which I would like to have your questions and comments concerning ballast deck cap renewal.

Shows Film.

President Chambers: Thank you, Mr. Denz and Mr. Tallant for another interesting and truly informative report.

Mr. Anthony will introduce the next speaker on "Prevention of Roofing Failures."

SPECIAL SUBJECTS COMMITTEE REPORT NO. 4

Prevention of Roofing Failures

COMMITTEE—KENTON N. KERNS, *Chairman*, Architect, Burlington Northern; C. R. LUND, *Vice-Chairman*, Engr.-Mech., Milwaukee Road; A. S. DRESDEN, Consultant, Mt. Prospect, IL; D. MIEDTKE, Proj. Mgr., Ellerbe Assoc.; E. E. RUNDE, Constr. Engr., ICG; J. F. PALMER, Exec. VP, Preston Pacific Corp.; P. SALETNIK, Asst. Engr. Bldgs., C&NW; W. C. STURM, Sr. Proj. Engr., EJ&E; A. S. UPPAL, Engr. B&S Mtce., CN.

I. The History of the Problem

A. An evolution in roofing

The forces acting on roofing from nature have not changed. The materials, systems, roof deck designs and application methods have changed. The result of the changes is an era of roofing problems. For example, in a recent roofing magazine some experts predicted that of new roofs constructed today fiteen percent will fail within five years, and of these failures, nine percent to thirteen percent will fail within sixty days.

Prior to World War II a roof was a sound investment for all, designed to last twenty years and often did. Railroad buildings had roofs of all types—metal, built-up, shingles, slate. Not all were free of problems, of course, usually they proved satisfactory. What has happened?

K. N. Kerns

B. The pricing spiral

Since World War II major changes have taken place. With rising prices, many innovations were attempted to simplify the system or reduce the labor. Many of these failed miserably. Roof decks became lightweight and flexible. Roof shapes and buildings became complicated. Environmental requirements restricted the use of some products.

With inflation, roofing felts and bitumens were modified and quality of these basic materials became uncertain. Roofers attempted to cut costs wherever they could, some workmanship was substandard and distrust set in, not unlike the used car business.

C. The energy crunch

Prior to the '73 oil embargo, asphalt products were inexpensive and consistent in performance. When shortages came many suppliers bought crude oil from new sources and the resulting asphalt did not perform as expected.

Insulation requirements created complicated systems and separated the roof membranes from the heat of the building, putting much greater stress on the roofing membrane.

Owners and roofers looking for solutions created a demand for change. More new roofing systems have appeared in the last ten years than over the last century.

II. Built-Up Roofing

A. Hot asphalt and coal-tar pitch roofs

1. In a built-up roof, the asphalt or coal-tar pitch bitumen provides the waterproofing, the felts simply hold the bitumen in place and add strength. Asphalt is a petroleum product and coal-tar pitch comes from coke and the steel industry.

In recoating an existing building, it is important that the correct bitumen be used: asphalt over asphalt and coal tar over coal tar.

Several methods are used for obtaining satisfactory blends of coal tar pitch and asphalts (particularly small percentages of asphalt dissolved in coal tar). The results of a field mixture are unpredictable and should be avoided whenever possible. Several methods may be used to determine which bitumen exists. Listed below are several tests which can be easily made in the field:

a. ODOR: Asphalt, when heated has a strong odor characteristic of fuel oil, while coal-tar pitch, when heated, has a strong odor with no resemblance to that of fuel oil.

b. SOLUBILITY: Asphalt is readily soluble in aliphatic solvents, such as gasoline, mineral spirits, and kerosene. Coal-tar pitch is not soluble or only slightly soluble in these materials. A cloth or paper wiper soaked in an aliphatic solvent and rubbed vigorously on asphalt will transfer a film of asphalt to the rag or wiper and make the asphalt surface very tacky to the touch. However, when rubbed vigorously on pitch, the cloth or wiper will become discolored, but will not transfer a film of pitch. The pitch will not become tacky to the touch.

c. FLOAT TESTING: Prepare a 16 percent solution of common salt (sodium chloride) in water. This can be obtained at a drug store, or can be roughly prepared by adding 1.7 pounds of salt to one gallon of water. Drop a small piece of the bituminous material into the salt solution. Asphalt will float whereas pitch will sink. Caution should be exercised not to include any foreign material, such as slag or dirt, in the specimen of bituminous material being tested. The salt solution can be reused if the container is kept tightly closed.

2. Identifying the problems

How can we identify problems that developed in built-up systems? Moisture entering a roofing system can freeze and cause splits and delamination at felts, insulation, and decking. Moisture also deteriorates roofing materials and causes insulation to lose its insulating value. It is necessary to design so as to prevent cracks, splits and other sources of moisture.

Roof spans have increased and lightweight decks have replaced solid, heavier ones. Roof areas have increased, requiring more concern with expansion joints. More mechanical equipment has been placed on the roof increasing problems of flashing. Lightweight decks are more flexible than the old concrete decks and the increased deflections increase the strain on the roofing membrane.

Temperature variations cause expansion and contraction of all elements of the roof system, including the deck, flashings, insulation and membrane. Any differential movement causes stresses between elements which can lead to delamination, separation or splits.

Pressures to reduce construction time can result in inconsistent coating of the roof deck with asphalt. If the adhesion to the deck is incomplete, the insulation boards move separately, and if other sections are adhered to the deck, the result is splits in the membrane, the insulation, and the flashings. If asphalt is not solidly mopped between plies leaving dry spots, "holidays," blisters will result.

Another problem is the storage of roofing materials during construction.

Subjecting the felts and insulation to rain, wind and weather without proper protection results in wet materials being built into the roof. Also the concentrated weight of materials stacked on a roof can damage the roof deck.

Another major cause for concern is poorly drained roofs which leave water standing and can only lead to accelerated deterioration, especially if the waterproofing membrane is asphalt. Once the waterproofing breaks down, moisture enters the roofing system and a multitude of problems result.

3. Solutions

If we know what causes these problems, how can we prevent them? Here are a few simple rules that can help.

a. Keep your roof shapes simple. An expansion joint should be installed every 150 linear feet. In addition, any change in direction should have a control joint installed.

b. A quarter of an inch per foot minimum slope should be built into every roof. Water should be gone in 24 hours after a rain, especially with asphalt or aluminum coating.

c. Eighty percent of early roofing problems originate at the flashings. The major condition which affects all metal-edged flashings is movement. Movement is caused by thermal change, wind, and in some installations, vibrations. Most metal-edged details have wood, nails, bitumen, felts, and metal, each with its own coefficient of expansion and contraction which, in turn, adds to roof stress. Consequently, a proper design should include a flashing made up of a rubberized material which will withstand the different levels of expansion and contraction. In addition, when the roof mat starts to oxidize, the felts have a tendency to shrink, possibly as much as 20 percent. The shrinkage can then be absorbed in the flexible membrane flashing, thereby eliminating the cracks and splits which normally occur during the first five years.

d. Make sure that the waterproofing membrane is applied strictly according to the manufacturer's specifications, including the deck. Specify decks with increased stiffness to reduce deck deflection. Do not exceed recommended deck spans. The waterproofing membrane should be no less than four plies, and preferably five ply. In addition, roofing materials must be protected, and at the end of the working day, a water cut-off must be applied to protect the insulation.

e. Under no circumstances allow "phased construction," that is, to build a ply or two of the roof to get the building "in the dry." It is almost impossible to gain adhesion in phased roofing.

f. Try to keep machinery off of the roof. If required they should be set with proper curbs and pitchpans. Include walkways for maintenance personnel.

g. Inspect the installation. Make sure that the bitumen is not overheated nor underheated (this can cause loss of adhesion), that the felts and insulation are dry and fully adhered to the roofing deck, and that the roofing plies and floodcoat are properly applied.

h. On existing roofs apply roof coatings and make repairs before serious deterioration occurs. Allow asphalt to weather before aluminizing and do not apply aluminum roof coating over coal tar.

i. Do not apply emulsion type roof coating over old dried out roofs without first priming.

III. Built-Up Roof Inspection and Maintenance

Take frequent looks at your roof. Good care of a roof begins with regular inspection of the roof premises for signs of weakness or repair. The biggest step in holding down maintenance expenses is to correct roofing problems as soon as possible.

You can expect any person to find the bad leaks, but it takes a qualified person to spot the small leaks. Your inspector has to know what to inspect and for what to look. Competent inspection includes many points—copings, parapets, flashings, skylights, ventilators, inside and outside walls, ceilings, etc.

Inspect the roof every six months, preferably in the early fall to anticipate winter weather, and in the early spring in preparation for the hot summer sun.

Special inspections of the roof should be made after a violent rain or windstorm, or after a nearby fire, or after workmen have been on the roof.

A drawing showing the roofs of all buildings in a location can be a big help in making roof inspections. Show on this plan the location of each roof, and when installed. Also state who did the job, the guarantee (if any) and approximate dimensions. Set up an inspection chart. After each inspection enter brief notes on the condition of the roof and the general nature and cost of repairs. This data will prepare you for the next inspection, and guide you on future repairs and choice of new materials and methods to be used.

One helpful technique is to note any weak points on the roof you feel does not need repair at least until after the next inspection, but must be checked at that time.

The best way to make sure that you do not overlook an important detail in roof inspection is to arm yourself with a checklist. You can easily make up your own form, or you might get one from a leading contractor. Use a separate sheet for each roof. A sample checklist is shown as Figure 1.

A typical checklist shows all major roof items in the left column, such as copings, parapets, roof deck, roof covering, drains and gutters, skylights and penthouses. Under each item is a subdivision of the point to be checked. For example, under roof covering you might list blisters, loose or torn seams, cracks, old patches, condition of mat. Across the top of the page are headings for vertical columns—condition okay, number of defects, repair at once, repair when convenient, check next inspection and special comments.

A good roof inspector will look at many things besides the roof mat for clues to actual leaks or those in the making. Obviously, the first thing to do is ask the people occupying the building if there are any known leaks. Such reports help pinpoint other symptoms later on.

We have grouped these symptoms into convenient parts of the roof structure.

1. **Exterior walls of the building**—Look for settlement cracks or other evidence of building movement that might have strained the flashing or displaced drainage facilities. Efflorescence—that whitish, powdery excretion from mortar joints—may mean there are leaks in the coping or parapet up above.

Interior walls—Stains or seepage indicate leaking walls or roof. Damp walls, chipped or discolored paint are clues to roof leakage.

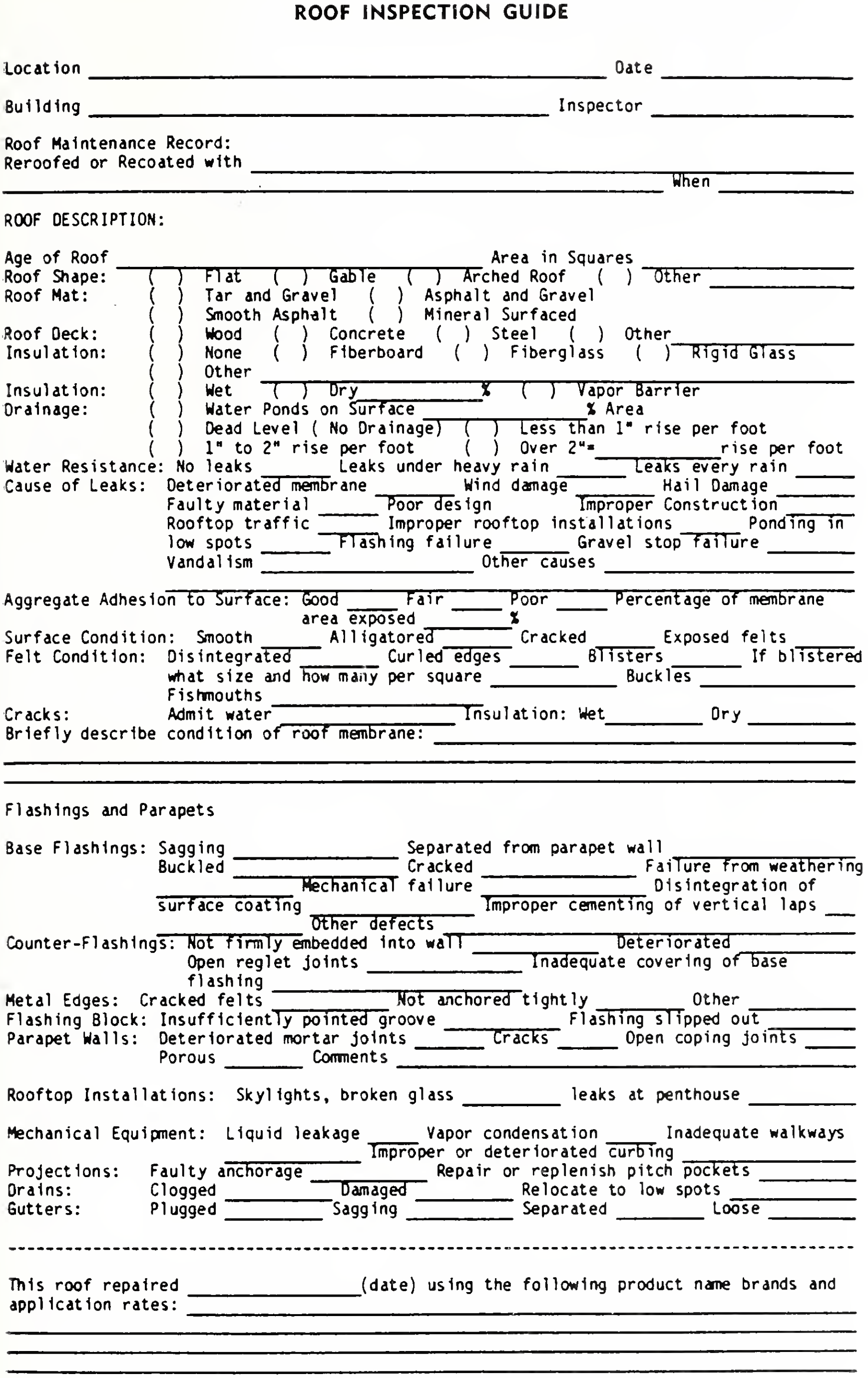
2. **Underside of roof deck**—Look for any signs of deterioration from leakage above. If the deck is of wood, list rotted or warped boards for replacement. Make a note to check roof above any water-marked boards.

If the deck is of concrete or gypsum, look for cracks and stains. Spots of rust might come from wet reinforcing rods. In a gypsum deck, leaking water usually causes spalling. In metal decks, rust spots mean trouble with condensation or leaks.

Topside—Only a few defects are apparent in a topside inspection. A sharp indentation or break at right angles to the boards in a wood deck points to a sprung board. If the roof mat gives under you, the board may be rotted. Secondary clues such as cracks in roofing felt may be due to cracks in the roof deck. It is always a good idea to check the roof deck from below wherever you find leaks or holes in the roof mat.

3. **Drainage**—Check for any changes in the original slope of the roof. Has any part of the deck sagged to produce hollows for standing water?

Drainage system—Make sure that no rain water accumulates on the roof during a rainfall. Slow acting drains and gutters may cause a backup of water above the parapet flashing. See that all drains are sound, flush to the roof, and



ROOF INSPECTION GUIDE

Location ______________________________ Date ____________

Building ______________________________ Inspector ____________

Roof Maintenance Record:
Reroofed or Recoated with ______________________________
______________________________ When ____________

ROOF DESCRIPTION:

Age of Roof ____________ Area in Squares ____________
Roof Shape: ( ) Flat ( ) Gable ( ) Arched Roof ( ) Other ____________
Roof Mat: ( ) Tar and Gravel ( ) Asphalt and Gravel
( ) Smooth Asphalt ( ) Mineral Surfaced
Roof Deck: ( ) Wood ( ) Concrete ( ) Steel ( ) Other ____________
Insulation: ( ) None ( ) Fiberboard ( ) Fiberglass ( ) Rigid Glass
( ) Other ______________________________
Insulation: ( ) Wet ( ) Dry ________ % ( ) Vapor Barrier
Drainage: ( ) Water Ponds on Surface ________ % Area
( ) Dead Level (No Drainage) ( ) Less than 1" rise per foot
( ) 1" to 2" rise per foot ( ) Over 2"= ________ rise per foot
Water Resistance: No leaks ______ Leaks under heavy rain ______ Leaks every rain ______
Cause of Leaks: Deteriorated membrane ______ Wind damage ______ Hail Damage ______
Faulty material ______ Poor design ______ Improper Construction ______
Rooftop traffic ______ Improper rooftop installations ______ Ponding in
low spots ______ Flashing failure ______ Gravel stop failure ______
Vandalism ____________ Other causes ____________

Aggregate Adhesion to Surface: Good ______ Fair ______ Poor ______ Percentage of membrane
area exposed ______ %
Surface Condition: Smooth ______ Alligatored ______ Cracked ______ Exposed felts ______
Felt Condition: Disintegrated ______ Curled edges ______ Blisters ______ If blistered
what size and how many per square ______ Buckles ______
Fishmouths ______________
Cracks: Admit water ______________ Insulation: Wet ________ Dry ________
Briefly describe condition of roof membrane: ______________________________
____
____

Flashings and Parapets

Base Flashings: Sagging ____________ Separated from parapet wall ____________
Buckled ____________ Cracked ____________ Failure from weathering
____________ Mechanical failure ____________ Disintegration of
surface coating ____________ Improper cementing of vertical laps ____
____________ Other defects ______________________________
Counter-Flashings: Not firmly embedded into wall ____________ Deteriorated ____________
Open reglet joints ____________ Inadequate covering of base
flashing ____________
Metal Edges: Cracked felts ____________ Not anchored tightly ________ Other ________
Flashing Block: Insufficiently pointed groove ________ Flashing slipped out ________
Parapet Walls: Deteriorated mortar joints ______ Cracks ______ Open coping joints ______
Porous ________ Comments ______________________________

Rooftop Installations: Skylights, broken glass ________ leaks at penthouse ________

Mechanical Equipment: Liquid leakage ______ Vapor condensation ______ Inadequate walkways
____________ Improper or deteriorated curbing ____________
Projections: Faulty anchorage ________ Repair or replenish pitch pockets ________
Drains: Clogged ________ Damaged ________ Relocate to low spots ________
Gutters: Plugged ________ Sagging ________ Separated ________ Loose ________

- -

This roof repaired ____________ (date) using the following product name brands and
application rates: ______________________________
____
____
____

FIGURE 1

clear of debris. If settlement or expansion has worked a drain above the roof level, reinstall it.

4. **Copings**—Coping troubles are usually of two kinds, either the coping material loses its water repellency and absorbs moisture, or the mortar in the coping joint cracks. In either case, water drains down into the parapet, and where it will finally come out is hard to tell. Often you can see the effects on the outside facing as you approach the building. More than likely, however, the leak will drain out of the inside facing, because of poor masonry work. Once frost gets in, mortar and bricks may be pushed out of the wall.

IV. Single Ply Roofing Systems

A. In order to avoid failures we need to understand the new generation of roofing systems being promoted. Before you specify or apply, know the limitations of the type of single-ply system with which you are dealing.

Different kinds of materials are used in single-ply systems. The types of materials presently in use include:

1. P.V.C. (Polyvinyl Chloride) Membrane Systems

   a. **Description:** P.V.C. is a thermoplastic polymer synthesized from vinyl chloride and a member of a larger group or polymers designated as "vinyls." P.V.C.'s are rigid materials which through plasticizing and proper formulation can show elastomeric properties and resistance to weathering. P.V.C. sheets are manufactured in approximately 34 mil, 48 mil and 60 mil thicknesses. Sheet sizes are fabricated up to approximately 6′ x 65′.

2. Synthetic Rubber Membrane Systems

   a. **Description:** The two major chemical formulations of synthetic rubber membranes sold are called Neoprene and E.P.D.M. (Ethylene Propylene Diene Monomer). They are both single-ply sheet rubber systems in thickness from 60 mil for an adhered system to 45 mil for a loose laid ballasted system.
   b. **Physical Properties—E.P.D.M. Sheet Membrane:** E.P.D.M. demonstrates superior ozone resistance and remains elastic through wide temperature fluctuations. E.P.D.M. is impermeable and resistant to ultraviolet radiation and weathering in general.

3. Modified Bitumen

   a. Asphalt (blown or unblown)

   b. Rubberizers may be added

   c. Other additives

B. Applications of Single-Ply Systems

1. A single-ply membrane can be applied in four different systems:
   a. Attached over insulation or approved roof deck using adhesives.
   b. Laid loose over approved roof deck or insulation, which is also laid loose, and ballasted with smooth stones or pavers.
   c. Mechanically attached over deck or insulation using rigid metal or rubber strips and flashed to make it watertight.
   d. Applied in any of the above methods with approved insulation on top and then ballasted.

V. Liquid Roof Coating Systems

A. General

1. Liquid applied roof coating systems are one of the newest generations of roofing to appear on the scene and hold the potential for taking a large share of the roofing market, in particular, roofs of unusual configuration. Because of the newness of the liquid coating systems, some questions do not have firm answers, such as: how long will they withstand weathering, how often will they require recoating, will mechanical damage due to hail, thrown objects, dropped tools, or foot traffic be of much concern? According to the manufacturers, their coatings in some instances have withstood 8,000 hours in a weatherometer with no loss of protection and no detrimental changes in properties. If these

VI. Comparison Chart

Item To Be Compared	Single-Ply Membrane Systems	Bituminous Roofs	Liquid Roof Coating System
1. Tear Off	Can usually be used over existing roofing.	Usually requires tear off for reroofing.	Not usually required.
2. Vapor Barrier	Usually not required as system breathes.	Required in high moisture building or blisters will occur.	Not required.
3. Slope	Can be dead level.	Needs tapered insulation or sloped roof structures.	Some need drainage.
4. Insulation	Can use the least expensive "Bead Board" insulation.	Requires more expensive insulation and more care.	Use spray on urethane insulation any thickness and can slope to drain.
5. Limitations to Installation	Can be applied in almost any weather.	Must be dry and not too cold.	Must be dry and warm.
6. Weight	Unballasted — 1/2 lb./SF Ballasted — 10 lb./SF	Unballasted — 1-4 lb./SF Ballasted — 5-8 lb./SF	Very lightweight.
7. Ballast	Must be smooth to prevent puncture 3/4" to 1-1/2" size	Can be gravel.	None required but granules often applied over coating.
8. Wood Blocking	Must not be creosote treated.	Any treatment is acceptable.	Not required.
9. Expansion and Contraction Joints	Not required.	Required.	Not required except over building joints.
10. Handling	Material and rolled membranes can be lifted to roof in fewer pieces.	Many rolls of felts and hot bitumin containers.	Spray on with hoses from ground.
11. Flashings	Flexible and easy. Not a weak point.	Primary location of leaks requires mixture of materials that move differently.	Monolithic, sprayed in place, self-flashing, no metal corrosion, conforms to walls and penetrations.
12. Shrinkage	Rubber: Generally not a problem.	Will shrink when bitumen drys out.	Must be taken into account especially in valleys where shrinkage can cause separation or loss of bond.

VI. Comparison Chart (Continued)

Item To Be Compared	Single-Ply Membrane Systems	Bituminous Roofs	Liquid Roof Coating System
	PVC: Some brands lose plasticizer causing shrinkage.		
13. Workmanship	Critical as membranes can be damaged during installation, seams must be kept clean and properly sealed.	Materials **must** be applied dry and flat with solid bituminous adhesive and coatings.	Critical, requires experienced applicators.
14. Installation time	Large, clean sheets reduce installation time.	Many plies and coatings.	Can be rapid installation depends on good weather. Two step application.
15. Conform to Shapes	Conforms easily to most shapes but must be adhesively or mechanically bonded as ballast cannot be used on steeply sloping roofs.	Not easily conformable.	Very readily conforms to difficult shapes. Major advantage of this system.
16. Problems	Sheets are flexible and remain elastic.	Subject to splits, cracks allegatoring and blisters.	Flexible and elastic but subject to mechanical damage and hail.
17. Seams	Fewer seams, sealed with adhesive, solvents or tapes. Seams can be a source of problems if not properly made.	Must be solidly mopped, sealed and coated.	No seams, monolithic.
18. Locating and repairing leaks	Difficult to locate. Easy to repair by patching or sealing.	Difficult to locate and difficult to repair.	Easy to locate and easy to repair applying new coating.
19. Maintenance	None required.	Must be recoated and repaired regularly.	Many need recoating.
20. Factor of Safety	Single-ply has no factor of safety.	Several plys. Some factor of safety.	Monolithic with insulation often will stop leaks until damage is repaired. Good factor of safety.

VI. Comparison Chart (Continued)

Item To Be Compared	Single-Ply Membrane Systems	Bituminous Roofs	Liquid Roof Coating System
21. Quality Control	Factory quality control better, also less effect of petroleum quality fluctuations.	More difficult to control. More field labor intensive.	Manufacturing quality can be controlled.
22. Contamination	Membranes can be damaged by contact with gasoline, oils, asphalt or coal tar unless specially formulated.	Damaged by solvents gasolines or oils.	Generally resistant to chemicals and solvents.
23. Combustibility	Can be Class I fire rated system when properly designed.	Can be Class I fire rated system when properly designed.	Can be designed to meet factory mutual or other fire codes.
24. Color	Can be light colored, black or color of ballast.	Black or color of ballast.	Light colored or color of coating granules.
25. Reusable	Can be rolled up and reused.	No	No
26. Effect of Ultraviolet	Rubber: Most are stable PVC: Many are stable	Stable, but will dry out with exposure.	Many are stable, some require granules or other coatings.
27. Contractor Preference	Most roofers prefer because of ease and quickness of system and no mess.	Hot kettles, fumes, mess environmental problems.	No mess, quick clean system.
28. History	Some systems have, some not, check individual product.	Long history.	Relatively short history.
29. Life Expectancy	Major brand products expect 20 years minimum, perhaps up to 40 years.	With **proper maintenance** 15 to 20 years.	With recoating and repair can be indefinite.
30. Warranty	5 to 10 years readily available. EPDM 15 year material warranty available.	Normal 2 year warranty.	5 to 10 year available.

findings are true, and if mechanical damage is determined to be insignificant, then they may become a viable alternative to other roofing systems. Most of these systems incorporate the use of a spray-on urethane foam insulation over the roof deck or over the existing roofing membranes. Since the urethane foam insulations today are highly susceptible to damage from ultraviolet radiation, they require a coating to protect them from U.V. and other elements.

2. Spray on coatings to protect urethane foam insulation include acrylic latex, silicone and urethane. Other types are appearing but this report will cover only these three.

> a. Acrylic: Low abrasion resistance and tensile strength, thus is more susceptible to hail and mechanical damage—lowest in weathering resistance, also, lowest in cost. Will freeze in can.
>
> b. Silicone Rubber: Low impact resistance and tensile strength, thus susceptible to hail and mechanical damage. Good weathering properties. Requires roof drainage.
>
> c. Urethane: Higher tensile strength and abrasion resistance, thus greater protection against hail. Resistant to ponded water.

VII. Metal Roofing Systems

A. General

1. Major changes have been made in metal roofing systems in recent years. Primarily, the use of standing seams and concealed fasteners which eliminate most through-roof fasteners, thus eliminating the majority of potential leaks. Aluminized steel greatly reduces corrosion.

2. With the use of roof purlins over existing roofing systems, metal or otherwise, a new metal roof can be applied over an existing system quite easily and insulation can be added in the purlin space, thus making it possible to insulate while installing a new roof covering.

VIII. Conclusions

Proper maintenance of existing built-up roofs can extend their useful life many years, but without maintenance life expectancy is greatly reduced.

Whether the roofing system selected for use is a built-up asphalt or tar roof, a single-ply membrane roof, a liquid applied membrane roof, or a metal roof, there are products on the market which will give a successful result. Good products and poor products are available in each category, thus caution is advised.

Some of the products in the new generation of roofing either reduce or possibly eliminate most maintenance. The life cycle costing of some newer products can often be lower.

Proper selection of the new or replacement roof to be used, care in its installation and diligence in maintenance will greatly reduce the small leaks that are such a headache and the large failures that are so costly.

President Chambers: Thank you, Mr. Anthony and Mr. Kerns. We appreciate your efforts and support in presenting a report of such scope and interest to the association.

Mr. Kapp will introduce the next speaker on "Locomotive Fuel Spill Prevention and Spill Collection Systems."

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SPECIAL SUBJECTS COMMITTEE REPORT NO. 1

Locomotive Fueling Spill Prevention and Spill Collection System

COMMITTEE—H. J. Laga, *Chairman*, Asst. Envr. Engr., C&NW, Chicago, IL; J. Robertson, *Co-Chairman*, Mgr. Engr. Design, B&LE, Greenville, PA; D. A. Bessey, Asst. Chf. Engr. Struc., Milwaukee, Chicago; R. Fronczac, Milwaukee, Chicago, IL; J. N. Michel, Mgr. Engr. Design, Amtrak, Washington, DC; J. T. Kapp, Proj. Engr., Conrail, Philadelphia, PA; F. D. Day, Sys. Engr. Strs., Conrail, Philadelphia, PA; T. Kuhn, Poll. Contr. Engr., MoPac, St. Louis, MO; B. Nye, Poll. Contr. Engr., MoPac, St. Louis, MO; D. C. Gould, Asst. Str. Engr., Union Pacific, Omaha, NE; A. P. Schoulties, Svce. Engr., Armco Steel Corp., Middletown, OH; D. R. York, Envr. Engr., C&NW, Chicago, IL; D. Collins, Tank Service, Inc.; American Petroleum Institute, Washington, DC.

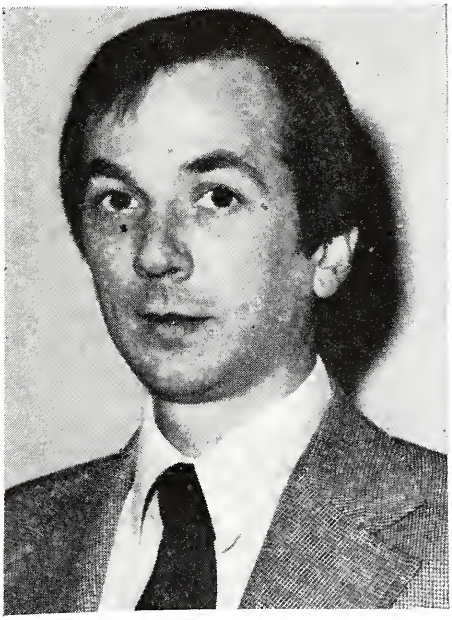
In 1969, the average cost of fuel oil was 10.17¢ per gallon and fuel conservation was practically nonexistent. Today, fuel cost averages about $1 per gallon, the market faces a limitless ceiling, and fuel conservation programs have now become company policy. All Class I railroads have major programs or studies underway to decrease fuel spillage and increase fuel efficiency in order to cope with rising fuel costs and shrinking supplies. One major railroad, in a 1979 diesel fuel-control study, estimated that fuel spilled, as a percentage of fuel dispensed, is in the range of 0.3% to 0.9% and can possibly be as high as 1.5%.

A simple, yet descriptive, example of fuel waste can be illustrated by a fuel nozzle leaking one quart of fuel per minute. This equates to 15 gallons an hour, 360 gallons a day. If the leak remains undetected, that nozzle can waste 131,040 gallons a year. At the current price of one dollar per gallon, a single "leak" can cost the company an eighth of a million dollars. If a railroad maintains 150 active nozzles, it would take only a mere 5% of leaky nozzles to produce a million dollar loss.

TABLE I

DIESEL FUEL WASTE

1	Quart/Minute
15	Gallons/Hour
360	Gallons/Day
2,520	Dollars/Week
131,040	Dollars/Year



Howard Laga

The causes that contribute to fuel spillage can occur in any one of the three phases of diesel fuel handling: receipt, storage and usage. Each mode has its own peculiar set of problems that result in spillage and require particular solution to prevent chronic occurrences.

Receipt:

Diesel fuel is received on-site either by tank car, tank truck, pipeline and, in some cases, by barge. Generally, the mechanical transfer routes are similar in that, through a certain pumphouse design, fuel will flow through a pattern of suction pumps, air eliminators, flow meters and check valves on its way to storage. Spillage during the unloading phase can result from several avenues, including leaking or broken pipes, damaged valves, poor or nonexistent venting, lax pressure relief and degraded pump packing. In addition, poorly illuminated unloading areas can contribute to factors that will propagate the frequency of accidental spillage. Spills during the unloading phase happen and the facility, regardless of an adept fuel safety and instruction program, must be prepared to contain and collect the spilled product.

Truck-unloading facilities should be designed with concrete, diked pads that can drain into an API separator. Hose discharge tanks should also be installed to recover fuel oil as vender disconnects from the pump house inlet. Tank car unloading ports can similarly be equipped with fiberglass or concrete pans that drain into a separator. Both systems provide containment and recovery of the spilled product while precluding any environmental infringements.

Spills and leaks are just as prevalent within the pumphouse and can easily be contained by diking the interior perimeter of the house and sloping the floor with drains that empty into the API separator. Pumphouses should be equipped with a variety of clean-up material to recover the spilled oil, such as absorbent clay granules or sorbent oil-philic products.

Waterfront fuel facilities services by barge are undoubtedly considered the most precarious unloading locations. Ever vigilant maintenance must be exercised to prevent even the slightest fuel spillage from destroying the sensitive water front ecosystem.

Such a facility must incorporate an Inspection and Maintenance (I&M) program that entails daily inspection of the flow system, the pipes, valves, meters, connections and pumps. If a problem from any of the above components occur, repair of the faulty unit must be given top priority to prevent a harmless leak from turning into a major spill. Consequently, a barge facility must store a sufficient inventory of oil-sorbent material to clean up an off-shore spillage. Products should include booms, pillows, and sheets with capabilities of collecting either heavy lubrication oil or No. 2 diesel fuel. On-site equipment might include a watercraft to employ collection and retention booms, oil-selective retrieval devices, pumps and tanks.

Storage Tanks:

Once the fuel is dispensed by the vender, the entrained air is eliminated, the temperature/volume reading is corrected, and the volume metered before it passes out to storage. This phase of fuel handling is the most static, generally closed to the atmosphere, and involves little or no mechanization. Because of this description, most spillage will result from time-dependent causes; i.e., rupture, corrosion, base erosion, and differential settlement.

Also, poorly maintained strapping tables or gauges, inept bookkeeping and personnel negligences will produce tank volume discrepancies that lead to the most common spillage problem—overfilling. Routine semi-annual inspection and maintenance that includes pressure testing of buried pipelines, visual inspections and, in the case of tanks, a system employing a non-destructive shell-thickness test should be sufficient to prevent the occurrence of the time-dependent causes. In addition, all facilities should have accurate bookkeeping to record receipts, usage and storage inventory.

Proper record keeping not only prevents negligent overfilling, but provides an accurate balance sheet to prevent vender fraud and in-house pilferage. The most critical feature of tank spill control is the erection of an oil-tight containment dike. Whether it is an earthen or concrete dike, the volume within the dike should have the storage capacity available to hold the volume of the largest tank in the drainage area plus freeboard for any expected precipitation. Recommended practice on many railroads is to design a dike with capacity of 1.5 times the volume of the largest tank. In the event of a spill from a diked tank, the facility should be equipped with pumps, filters and tanks to recover the spilled oil.

The Environmental Protection Agency promulgated a regulatory vehicle, the Spill Prevention Control and Countermeasure plan (SPCC) to insure proper operation of facilities involved in storage, transfer, distribution and consumption of oil. The SPCC issues regulations that establish procedures, methods, equipment and requirement for equipment to prevent discharge of oil and hazardous substances from on/offshore facilities as well as regulations as how to contain such discharges.

The SPCC plan is the primary tool to insure safe, immediate containment of an oil spill to a limited area for the prevention of widespread adverse effects on land or water. The plan serves as a precise, effective guide to lead field personnel through a spill. It should contain an introductory synopsis of the fueling site with information about the flow system from inlet to outlet, the piping, valves and the pumps. In addition to general maintenance practices, the plan must contain a complete notification list of responsible in-house personnel, a listing of governmental agencies (i.e., federal and state EPA, coastguard, local fire and police departments), and a supplemental list of outside contractors with equipment to augment the containment/clean-up effort. According to the plan, provisions and methods for a practical and immediate effort must be available to contain the oil and safeguard life and property.

Furthermore, the plan must outline methods to remove and dispose of the spilled oil. To insure proper clean up, it would be prudent that the plan include a list of material and equipment necessary to combat an oil spill. A yearly inventory of on-site emergency materials will insure an immediate response when time is critical.

A copy of the plan must be distributed to all responsible personnel, onsite and attainable at all times.

Fuel Oil Handling Facility— Locomotive Fueling Areas

The locomotive-fueling site is undoubtedly the largest contributor to fuel oil spillage. When you consider the task of fueling a multi-unit consist at rates of 200 GPM, the location is prime for a variety of mechanical failures and human negligences that result in spillage. In the aforementioned study, that railroad also analyzed their massive fuel distribution system to determine the discreet causes of fuel spillage.

Their findings, common to all railroads, revealed the following causes and percentage of occurrence of the total spillage:

Failure of automatic shutoff	57%
Overriding automatic shutoff to top off tank	24%
Worn/defective coupling and gaskets	9%
Locomotive pull-away before disconnect	1%
Other causes	9%

As frequent and calamitous as spills can be at this location, they cannot be written off as inevitable or "normal" operations. Spills and the frequency at which they occur can be controlled by the institution of two separate comprehensive programs. The first entails a coordinated effort between mechanical and maintenance personnel to maintain and equip the fueling locations, locomotive equipment and other fueling appurtenances. The second program is a comprehensive educational and instructional policy (constructed by a multi-departmental committee) that delineates the need for fuel oil control, the responsibility of fuel oil handling and the benefits of a no-spill conservation program.

Regardless of the thorough and comprehensive nature of any spill-prevention program, spills do occur at such frequencies (and magnitude) to warrant the installation of permanent fuel collection and treatment equipment. The most common type of collection system is the track pan. Pans can be made of fiberglass, steel, concrete or fuel resistant rubber modules. Pans, center and side panels, should be installed to cover the entire fuel-dispensing area, as well as ready tracks. Fuel-unloading devices (stanchions) should be surrounded by concrete splash pads slightly sloped to drain into the track pan collectors.

Fueling nozzle technology has come a long way from the hydraulic hardware installed at fueling sites prior to 1950. Many railroads have reviewed the options of available equipment to rehabilitate their present system. New vacuum or electronic control systems offer a greater control of leakage and/or spillage during refueling, while maximizing protections against manual override and topping-off.

Such adept systems will help minimize environmental liability and reduce the manhours needed to presently maintain the present nozzles.

Once the spill product is contained within a collection system, it can be routed to a variety of treatment units to possibly recover the product. Perhaps the simplest form of treatment is the API Separator which detains an oil/water mixture long enough for the components to separate by their specific gravities. Weirs, siphon dams, and catch basins equipped with an oil recovery device will accomplish the same treatment. More sophisticated treatment methods route oil, water and process waste streams to Dissolved Air Flotation (DAF) or Induced Air Flotation (IAF) units. All the above systems share the common goal of treating and recovering fuel oil for reclamation and/or reuse.

The benefits of fuel oil recovery can be converted to economical benefits by offsetting the cost of operating and maintaining the treatment facility. In addition, fuel oil, slightly contaminated, is an excellent energy source for diesel house boilers.

Railroad Fuel Conservation Programs

Most railroads have, since the first full crunch in 1972, implemented some sort of conservation program, while other roads have been actively practicing fuel conservation prior to it becoming fashionable.

One eastern railroad undertook a comprehensive study to investigate the causes and develop solutions to the fuel-oil waste problem.

A study group, comprised of department members intimately or remotely involved with fuel handling, examined every intricacy of the control problem. After a thorough review, their findings were collated to form the criteria needed to establish a comprehensive fuel control program. This included:

1. That fuel must physically be controlled in storage and transit.
2. Records and transaction documentation must be standardized, traceable and complete.
3. Responsibilities/accountabilities must be clearly defined and enforced.
4. All fixed facilities and vehicles must be properly managed.
5. An investment in fuel and fueling equipment must be implemented and managed.
6. Constructive measures must be taken to establish a fuel conservation ethic among employees.

Made Systemwide Study

As a result of the drastic increase in the cost of fuel oil, a Midwest railroad formed a committee to conduct a systemwide review to study and update their fuel controls. Site visits were made to ascertain the status of the control system in regard to receipt, storage and usage. Upon review of the data, the committee immediately formulated a three-phase program to:

1. Outfit each site with receipt and

usage meters to help tighten accounting procedures and guarantee all fuel is received and recorded.

2. Install a remote storage tank gauging and inventory control system. This involves tele-electronic communications to monitor continuous tank storage data including level, temperature, level alarms, gross and temperature corrected volumes and total inventory from all tanks on the system. In addition, it served as a spontaneous check and balance against field meter accountability.
3. Implement a mixed bag of security measures, maintenance procedures and possible metering of individual stanchions.

Training Personnel

Lastly, a unique approach to the problem has been conducted by another Midwest line. Instead of placing their main emphasis upon upgrading the physical or mechanical components of fuel handling, this railroad directed their effort toward personnel instruction. In program form, instruction revolves around such subjects as: (1) the need for fuel conservation; (2) personal safety/injury costs; (3) a historical perspective on fuel cost; (4) economics of maintaining fueling equipment; and (5) legal and environmental aspects. Other topics such as spill containment and collections, spill reporting and clean-up are included.

The most important feature emphasizes proper handling of equipment and fueling procedures at the stanchion. Personnel is instructed on locomotive placement nozzle inspection, mechanical components, automatic shut-off, manual override, locking devices and the importance of seals and gaskets. The whole program, though technically oriented, presents an underlying theme for the need to prevent spillage and conserve fuel, while instilling a sense of pride and importance toward their duties.

In conclusion, it is evident that the single most important aspect of fuel conservation lies in education. Instructional programs must continuously be offered to emphasize the importance of safety, job responsibility and the economical and environmental benefits of spill prevention. Without this commitment of management and labor to adhere to a strict fuel-conservation regime, the finest conservation program woudn't be worth the price of paper it is written on.

President Chambers: Thank you, Mr. Kapp and Mr. Laga.

With the EPA and other public agencies monitoring all types of pollution and arbitrarily demanding strict controls, your subject was most timely. In the best tradition of our association we share experiences and expertise, which certainly is in the best interests of all railroads.

That was our final report. We will now continue the business end of this session.

Our Association each year elects three members to serve as Directors for three years. Personally, and on behalf of the Association, I wish to thank our three outgoing directors Mr. Davidson, Mr. Russell and Mr. Williams for their dedicated service to the Association and their assistance to me during my term as president.

In addition our senior vice president, Mr. Ray McMasters has tendered his resignation effective with the close of this conference. He has served on the executive committee for six years along with contributions prior to that. Mr. McMasters was to have taken over as president this year. We are sorry to see him leave.

Will you gentlemen please come forward?

As an expression of the Association's appreciation for your service I am pleased to present to you these plaques.

As this is my final appearance before you as President, I do thank all the officers, directors, committee chairmen and committee members and express my deep appreciation for their help, cooperation and support during my term.

It takes much work by many people to turn out a successful conference.

Now then, you have previously heard the report of nominating committee.

Will Mr. Gould please read it again?

Do we have any further nominations from the floor?

— Pause —

I will accept a motion that the slate of members submitted by the nominating committee be accepted and elected.

Pause for motion.

Will someone second the motion?

Those in favor say "aye."

Those opposed "No."

I declare these officers duly elected.

Will the gentlemen please step forward to be recognized. These are your new officers for the coming year.

Will the REMSA representative please come forward to greet our new president. Thank you, sir.

(Acceptance Statement)

President Hyma: I do consider being elected President of this Association a great honor and will do my best to live up to the high standards set by my predecessors. Speaking of predecessors, on behalf of the Association and myself, I want to thank Joe Chambers for the outstanding job he has done this year and I would like to present this plaque in recognition of his service as President of this Association.

We will continue to benefit from Joe's experience as he will continue to serve on our Executive Committee.

I want to personally congratulate our new vice presidents, Jim Budzileni and Jim Williams. Both have served most capably as directors and will continue to do so in this new position. Also, I want to welcome our new directors, Mr. Laga, Mr. Uppal and Mr. Davidson who is now returning for a full term.

Our next conference will be in New Orleans in October along with the REMSA equipment show. I am sure all of you will be planning to attend and I want to ask your help in making it as worthwhile and as successful as possible. You will soon be receiving a Newsletter listing the Committee subjects for next year's reports. You will be asked to return a card indicating your willingness to serve on a committee and share your knowledge and experience on one of these subjects. This sharing of information is what this Association is all about and I ask you to do your part. Send in the card promptly and help us get off to a fast start in planning next year's conference.

Does anyone have any other matters to be brought before this meeting? If not, it is time to draw for our door prizes.

Meeting adjourned.

Constitutional Amendment

The intent and past history of the Association has been to appoint the secretary by a majority vote of the Executive Committee rather than by filling the position through election by majority vote of the members at the annual meeting, which is a requirement for election of all officers per Article VI, Section 1 of the Constitution.

Past practice has also been to fill the position of the secretary with one most qualified in the skills of the secretarial profession and not require the secretary to also be a person in a position above rank of gang foreman in connection with engineering, construction and maintenance for railway buildings, etc. as required for membership into the Association per Article III, Section 2 of the Constitution.

Article III, Section 8 of the Constitution clearly requires officers of the Association to also be members of the Association.

A solution appears to be that of not requiring the secretary to be an officer of the Executive Committee, or a full member of the Association. The secretary could be an associate member of the Association which provides all rights of membership except those of voting and holding office. See Article III, Section 4 of the Constitution.

To effect this course of action, the following changes in the Constitution are necessary:

1. Article IV, Section 1, drop words "a secretary."
2. Article VI, change title of section to read "Election of Officers and Secretary and Tenure of Office."
3. Article VI, Section 2, drop word "Secretary" in first sentence.
4. Article VI, Section 3, change to read, "The term of office of the treasurer may be terminated at any time by two-thirds vote of Executive Committee. The compensation of the treasurer shall be fixed by a majority vote of the Executive Committee."
5. Article VI, add new Section 4, "The secretary shall be appointed by a majority vote of the Executive Committee and the term shall terminate with the appointment of successor. The Executive Committee shall have the power, by two-thirds vote, to remove the secretary and appoint his successor at any time. The salary of the secretary shall be decided by a majority vote of the Executive Committee."
6. Article VI, Section 4, renumber to "Section 5."

The Constitution amendment shall be presented at the next regular meeting for approval by a two-thirds vote of the members present, with notice of proposed amendment having been sent to the members at least 30 days prior to the Annual Conference.

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	C. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	C. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Turner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemnnd	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Kransch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Kransch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCoy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	....	....	F. O. Whiteman	A. G. Shaver
Treasurer	....	....	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1962 ‡ To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Treasurer	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954-1955	1955-1956	1956-1957	1957-1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhause	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens W. H. Bunge E. R. Schlaf J. F. Warrenfells H. D. Curie J. M Lowry	J. F. Warrenfells H. D. Curie J. M. Lowry W. H. Bunge E. R. Schlaf G. W. Benson	W. H. Bunge E. R. Schlaf G. W. Benson J. M. Lowry T. M. von Sprecken H. A. Matthews	G. W. Benson J. M. Lowry H. H. Matthews T. M. von Sprecken W. H. Bunge E. R. Schlaf

	1958-1959	1959-1960	1960-1961	1961-1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhause	L. C. Winkelhaus	L. C. Winkelhause
Directors	J. M. Lowry R. C. Baker W. H. Bunge E. R. Schlaf H. A. Matthews M. J. Hubbard	W. H. Bunge E. R. Schlaf H. A. Matthews M. J. Hubbard R. C. Baker R. H. Miller	H. A. Matthews M. J. Hubbard R. C. Baker R. H. Miller Shirley White H. M. Wilson	R. C. Baker R. H. Miller Shirley White H. M. Wilson R. D. Hellweg F. W. Hutcheson

	1962-1963	1963-1964	1964-1965	1965-1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White H. M. Wilson R. D. Hellweg F. W. Hutcheson W. F. Armstrong J. W. DeValle	R. D. Hellweg F. W. Hutcheson W. F. Armstrong J. W. DeValle J. A. Goforth E. R. Simmons	W. F. Armstrong J. S. Ellis J. A. Goforth E. R. Simmons N. D. Bryant A. R. Dahlberg	J. A. Goforth E. R. Simmons N. D. Bryant A. R. Dahlberg J. S. Ellis T. L. Fuller

	1966-1967	1967-1968	1968-1969	1969-1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fulle	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant A. R. Dahlberg H. F. Lucas J. S. Ellis T. L. Fuller R. A. Youngblood V. D. Raessler W. L. Short C. E. Wachter	J. S. Ellis T. L. Fuller R. A. Youngblood H. F. Lucas W. L. Short C. E. Wachter A. C. Jones W. H. Rankin E. E. Runde	N. F. Lucas W. L. Short C. E. Wachter A. C. Jones W. H. Rankin E. E. Runde T. A. Reynolds J. J. Ridgeway J. R. Williams	W. H. Rankin E. E. Runde T. A. Reynolds J. J. Ridgeway J. R. Williams J. W. Chambers R. E. Frame J. C. Hobbs

	1970-1971	1971-1972	1972-1973	1973-1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds J. J. Ridgeway J. R. Williams J. W. Chambers R. E. Frame J. C. Hobbs R. K. Corbett J. R. Iwinsky J. S. Pritchett	J. W. Chambers R. E. Frame J. C. Hobbs R. K. Corbett J. R. Iwinsky J. S. Pritchett D. C. Gould W. S. Stokeley W. C. Sturm	R. K. Corbett J. R. Iwinski J. S. Pritchett D. C. Gould W. S. Stokeley W. C. Sturm J. W. Davidson C. A. Hughes W. R. Hyma	D. C. Gould W. S. Stokely W. C. Sturm J. W. Davidson C. A. Hughes W. R. Hyma O. C. Denz R. C. McMaster W. E. Brakensiek

	1974-1975	1975-1976	1976-1977	1977-1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson C. A. Hughes W. R. Hyma W. E. Brakensiek O. C. Denz R. C. McMasters F. B. Lindsay, Jr. M. Noyszewski Jim Payne	W. E. Brakensiek O. C. Denz R. C. McMasters F. R. Lindsay M. Noyszewski W. C. Sturm W. J. Gunkle W. E. Halley K. L. Wammel	J. W. Chambers M. Noyszewski W. J. Gunkle W. E. Halley K. L. Wammel J. Budzileni B. J. King J. G. Robertson	W. J. Gunkle W. E. Halley K. L. Wammell J. Budzileni B. J. King J. G. Robertson O. C. Denz E. C. Patterson W. S. Stokely

	1978-1979	1979-1980	1980-1981
President	W. C. Sturm	D. C. Gould	J. W. Chambers
Sr. V.-Pres.	D. C. Gould	J. W. Chambers	R. C. McMaster
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster	W. R. Hyma
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma	O. C. Denz
Secretary	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. F. Armstrong	W. F. Armstrong	W. F. Armstrong
Directors	J. Budzileni B. J. King J. G. Robertson O. C. Denz E. C. Patterson W. S. Stokely L. D. Green C. M. Russell J. M. Williams	O. C. Denz W. J. Gunkle W. S. Stokely L. D. Green C. M. Russell J. M. Williams D. A. Bessey J. N. Michel P. H. Saletnik	J. W. Davidson C. M. Russell J. M. Williams D. A. Bessey J. N. Michel P. H. Saletnik O. D. Anthony J. T. Kapp D. J. Lewis

HISTORICAL INFORMATION

List of Annual Conventions

No.	Place of Meeting	Date	Membership
1	St. Louis, Mo.	Sept. 25, 1891	60
2	Cincinnati, Ohio	Oct. 18-19, 1892	112
3	Philadelphia, Pa.	Oct. 17-19, 1893	128
4	Kansas City, Mo.	Oct. 16-18, 1894	115
5	New Orleans, La.	Oct. 15-16, 1895	122
6	Chicago, Ill.	Oct. 20-22, 1896	140
7	Denver, Colo.	Oct. 19-21, 1897	127
8	Richmond, Va.	Oct. 18-19, 1898	148
9	Detroit, Mich.	Oct. 17-19, 1899	148
10	St. Louis, Mo.	Oct. 16-18, 1900	143
11	Atlanta, Ga.	Oct. 15-17, 1901	171
12	Minneapolis, Minn.	Oct. 21-23, 1902	195
13	Quebec, Canada	Oct. 20-22, 1903	223
14	Chicago, Ill.	Oct. 18-20, 1904	293
15	Pittsburgh, Pa.	Oct. 17-19, 1905	313
16	Boston, Mass	Oct. 16-18, 1906	340
17	Milwaukee, Wis.	Oct. 15-17, 1907	341
18	Washington, D. C.	Oct. 20-22, 1908	368
19	Jacksonville, Fla.	Oct. 19-21, 1909	393
20	Denver, Colo.	Oct. 18-20, 1910	428
21	St. Louis, Mo.	Oct. 17-19, 1911	499
22	Baltimore, Md.	Oct. 15-17, 1912	524
23	Montreal, Quebec	Oct. 21-23, 1913	570
24	Los Angeles, Cal.	Oct. 20-22, 1914	586
25	Detroit, Mich.	Oct. 19-21, 1915	665
26	New Orleans. La.	Oct. 17-19, 1916	710
27	Chicago, Ill.	Oct. 16-18, 1917	704
28	Chicago, Ill.	Oct. 15-17, 1918	716
29	Cleveland, Ohio	Oct. 21-23, 1919	776
30	Atlanta, Ga.	Oct. 26-28, 1920	840
31	New York, N. Y.	Oct. 18-20, 1921	850
32	Cincinnati, Ohio	Oct. 17-19, 1922	865
33	Seattle, Wash.	Oct. 16-18, 1923	846
34	Kansas City, Mo.	Oct. 21-23, 1924	837
35	Buffalo, N. Y.	Oct. 20-22, 1925	759
36	Richmond, Va.	Oct. 12-14, 1926	750
37	Minneapolis, Minn.	Oct. 18-20, 1927	754
38	Boston, Mass.	Oct. 23-25, 1928	755
39	New Orleans, La.	Oct. 15-17, 1929	755
40	Louisville, Ky.	Oct. 21-23, 1930	713
41	Chicago, Ill.	Oct. 16-18, 1934	592
42	Chicago, Ill.	Oct. 15-17, 1935	547
43	Chicago, Ill.	Oct. 20-22, 1936	588
44	Chicago, Ill.	Oct. 19-21, 1937	566
45	Chicago, Ill.	Oct. 18-20, 1938	589
46	Chicago, Ill.	Oct. 17-19, 1939	546
47	Chicago, Ill.	Oct. 15-17, 1940	610
48	Chicago, Ill.	Oct. 14-16, 1941	594
49	Chicago, Ill.	Oct. 20-22, 1942	618
50	Chicago, Ill.	Oct. 20-21, 1943	597
51	Chicago, Ill.	Sept. 17-19, 1946	698
52	Chicago, Ill.	Sept. 16-18, 1947	651
53	Chicago, Ill.	Sept. 20-22, 1948	652
54	Chicago, Ill.	Sept. 12-14, 1949	676

No.	Place of Meeting	Date	Membership
55	Chicago, Ill.	Sept. 18-20, 1950	713
56	Chicago, Ill.	Sept. 17-19, 1951	676
57	Chicago, Ill.	Sept. 15-17, 1952	667
58	Chicago, Ill.	Sept. 15-17, 1953	666
59	Chicago, Ill.	Sept. 13-15, 1954	682
60	Chicago, Ill.	Sept. 19-21, 1951	625
61	Chicago, Ill.	Sept. 18-20, 1956	657
62	Chicago, Ill.	Sept. 23-25, 1957	769
63	Chicago, Ill.	Sept. 15-17, 1958	828
64	Chicago, Ill.	Sept. 15-17, 1959	863
65	Chicago, Ill.	Sept. 19-21, 1960	932
66	Chicago, Ill.	Sept. 18-20, 1961	968
67	Chicago, Ill.	Sept. 10-12, 1962	942
68	Chicago, Ill.	Oct. 14-16, 1963	887
69	Chicago, Ill.	Sept. 14-16, 1964	860
70	Chicago, Ill.	Sept. 13-15, 1965	829
71	Chicago, Ill.	Sept. 26-28, 1966	800
72	Chicago, Ill.	Oct. 11-13, 1967	799
73	Chicago, Ill.	Sept. 9-11, 1968	825
74	Chicago, Ill.	Sept. 9-11, 1969	746
75	Chicago, Ill.	Sept. 28-30, 1970	709
76	Chicago, Ill.	Sept. 13-15, 1971	719
77	Chicago, Ill.	Sept. 18-20, 1972	706
78	Chicago, Ill.	Sept. 17-19, 1973	750
79	Chicago, Ill.	Oct. 1- 3, 1974	683
80	Chicago, Ill.	Sept. 15-17, 1975	672
81	Chicago, Ill.	Sept. 13-15, 1976	674
82	Chicago, Ill.	Sept. 26-28, 1977	670
83	Chicago, Ill.	Sept. 18-20, 1978	663
84	Atlanta, Ga.	Oct. 15-18, 1979	642
85	Chicago, Ill.	Sept. 15-17, 1980	652
86	Chicago, Ill.	Sept. 14-16, 1981	683

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1.* The membership of this association shall be divided into four classes, viz: Members, life members, associate members and honorary members.

Section 2.* A member shall be a person in a position above rank of gang foreman in connection with engineering, construction and maintenance for railway bridges, buildings and water service facilities: or in the employ of a public regulatory body, a professor of engineering or architecture, a technical editor, a government or private timber expert, a consulting engineer, or an engineer in his employ, engaged in the engineering, construction and maintenance of railroad-related facilities or an engineer employed by a technical service or research and development organization, an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this association. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

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*Amended September, 1976.

** Amended September 20, 1948

†† Amended March 10, 1958.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8.[**] Only members shall hold office in this association, and only members and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1[‡‡]. The officers of the Association shall be a President, two Junior Vice Presidents, a Senior Vice President, a Secretary, a Treasurer and nine Directors, who, with the most recent Past President, shall constitute the Executive Committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the executive committee, at which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.[**] The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2[‡‡]. The President, two Junior Vice Presidents, Secretary, and Treasurer shall hold office for one year and the Directors for three years; three Directors being elected each year. The Senior Vice President shall hold office for one year and ascend to the office of President at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A Director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.[†] The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section. 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

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[*] Amended October 16, 1941.

[†] Amended September 21, 1957.

[§] Amended September 28, 1966.

[‡‡] Amended September 20, 1978

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears, may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applicants) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

***DUES

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:*

Members, $7.00; Associate Members, $7.00.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

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† Amended October 17, 1940.

* Article adopted 1922.

** Amended September 20, 1948

‡ Amended September 21, 1957.

*** Amended September 15, 1965.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7.‡‡ The Vice-Presidents in order of seniority shall preside at meetings in the absence of the President and discharge his duties in case of a vacancy in his office. The Senior Vice President shall have the senior position of Vice Presidents.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.# After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

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‡ Adopted October 17, 1940.

Amended December 4 1950.

† Amended September 20, 1948.

‡ Amended September 21. 1957.

‡‡ Amended September 20, 1978

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

---

† Amended September 20, 1948.

DIRECTORY OF MEMBERS

As of Feb. 15, 1982

HONORARY MEMBERS

Benson, G. W.
Dick, M. H.
Dove, R. E.
Gunderson, R. R.
Huffman, W. H.
Jorlett, J. A.
Schlaf, E. R.

LIFE MEMBERS

Armstrong, W. F.
Arnold, L. K.
Baker, F. A.
Barr, A. S.
Barsema, M.
Beaver, J. F.
Bell, D. V.
Beringer, M. A.
Bishop, D. B.
Boehling, H. A., Jr.
Bowman, R. M.
Bradfield, R. G.
Buckmaster, W. A.
Bunge, W. H.
Burch, E. E.
Burleson, H. S.
Burpee, C. M.
Camelle, E. J.
Carlson, A. W.
Carter, J. W.
Celander, H. W.
Chamberlain, P.
Christianson, H. B.
Clark, W. H.
Cooper, S. A.
Cross, E. T.
Cummins, C. P.
Davis, H. E.
DeValle, J. W.
Dixon, C. E.
Duchac, J. V.
Eargle, J. M.
Eichenlaub, C. M.
Elliott, C. E.
Enstrom, W. A.
Erskine, J. A.
Forseth, C. E.
Fort, O. E.
Fox, R. L.
Gipson, C. G.
Goforth, J. A.
Hawley, I. H.
Hedley, W. J.
Hellweg, R. D.
Hendrix, W. P.
Hickok, B. M.
Hodgkins, E. W.
Hogel, E. C.
Howard, J. G.
Howe, A. K.
Hornig, F. F.
Hubbard, M. J.
Humphreys, R. W.
Hunter, A. L.
Hutcheson, T. B.
Hutcheson, W. A.
Hutto, J. E.
Jackson, T. E.
Jenkins, H. W.
Johnson, A. C.
Johnson, E. A.
Johnson, H. T.
Jones, W. J.
Kendal, J. T.
Kieckers, E. W.
Kvenberg, S. E.
Laurick, M. J.
Leach, A. L.
Linn, G. A.
Little, H. C.
Lokotzke, G. P.
Lowry, J. M.
Lund, C. V.
Mabry, D. B.
Martens, W. F.
Martin, J. W.
Messman, D. V.
Meyers, B. R.
Moore, I. A.
Moris, R. F.
Myers, E. T.
Myers, R. L.
Oest, W. C.
Ostrom, W. D.
Packard, B. G.
Pahl, W. H., Jr.
Patterson, C. C.
Patterson, C. A.
Patterson, J. M.
Perrier, J. L.
Peterson, N. E.
Presthus, E. J.
Pritchard, B. L.
Prude, G. F.
Raessler, V. D.
Rainey, W. H.
Rankin, W. H.
Rees, F. L.
Reger, J. H.
Robinson, G. E.
Rothell, R. D.
Runde, E. E.
Safley, J. R.
Salmon, J. M., Jr.
Sathre, C. O.
Saunders, T. D.
Schmitz, J. F.
Seley, L. L.
Seltzer, J. W.
Shamblin, R. E.
Short, W. L.
Simonson, E. F.
Sinclair, C. H.
Slagle, G. P.
Smith, H. E.
Smith, J.
Smith, R. H.
Switzer, G.
Tardy, F. E.
Taylor, W. L.
Termunde, W. L.
Tetreault, L. J.
Thatcher, C. H., Jr.
Throckmorton, W. B.
Trulove, J. D.
Tucker, N. R.
Tustin, E. O.
Tyckoson, E. G.
Tyler, W. R., Jr.
VanScoyoc, L.
Von Behren, G.
Wachter, C. E.
Wall, R.
Wang, A. B.
Warfield, H., Jr.
Warfield, W. B.
White, S.
Whitehouse, B. M.

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Williams, C. B.
Williams, D. R.
Williamson, H. M.
Wingerson, C.
Wohlschlaeger, M. A.
Wold, O. R.
Wood, R. E.
Woolford, F. R.
Worden, R. K.
Yaw, D. W.

ALPHABETICAL LIST OF ALL MEMBERS

M Indicates Member
A " Associate Member
L " Life Member
H " Honorary Member

(Figures following name indicate year in which membership became effective)

A

Abbott, E. L. (A'69), Sales Engr., General Railway Signal Co., 2120 Prudential Plaza, Chicago, Ill. 60601
Alexander, R. W. (A'79), Pres., R. W. Alexander Contractors, Inc., P.O. Box 1592, Valdosta, Ga. 31601
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Alley, F. T. (M'55), Engr. Br. Maint., S.P., Houston, Tex. 77035
Anderson, D. A. (M'80), Supvr. B.&B., D.M.&I.R., Proctor, Minn. 55810
Anderson, H. E. (A'74), Mgr. Opers., Osmose Company, 4546 Tompkins Dr., Madison, Wis. 53716
Anderson, R. D. (A'67), Consultant, Griffin International, 140 Brightwood Ave., Westfield, N.J. 07090
Andrews, D. J. (M'69), B.&B. Supvr., C.&N.W., Menomonee Falls, Wis. 53051
Anthony, O. D. (M'71), Asst. Ch. Engr.-Br. & Str., B.&A., Bangor, Me. 04401
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Aust, J. K. (M'74), Asst. Ch. Engr. Const. Des., B.N., Englewood, Co. 80110
Autrey, W. S. (M'71), Ch. Engr., A.T.&S.F., Chicago, Ill. 60604
Aylward, P. E. (M'76), Rdm., W.P., Quincy, Calif. 95971

B

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Barr, A. S. (M'66, L'81), Ret. Ch. Reg. Engr., P.C., 1219 Firston Circle, Pittsburgh, Pa. 15241
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Barsema, M. (M'58, L'75), Ret. M.&B. Supvr., C.&N.W., 28W732 Geneva Rd., West Chicago, Ill. 60185
Bartley, C. W. (M'66), B.&B. Supvr., B.N., Glendive, Mont. 59330
Baryluk, R. M. (M'80), B.&B. Mast., C.P., Brandon, Man., Canada
Baxter, F. W. (M'77), Supvr. Strs., C.V., St. Albans, Vt. 05478
Beaver, J. F. (M'50, L'65), Ret. Ch. Engr., Sou., P.O. Box 1548, Holmes Beach, Fla. 33509
Bechly, D. S. (M'68), Engr. Strs., I.C.G., Chicago, Ill. 60601
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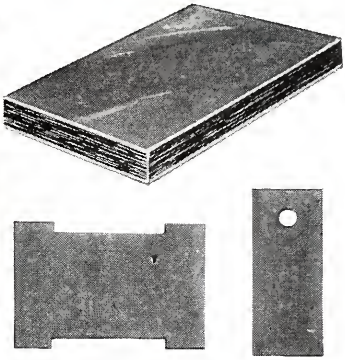
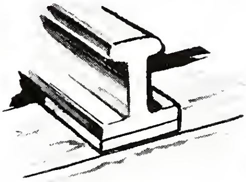
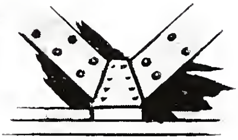


Bridges



Railroads



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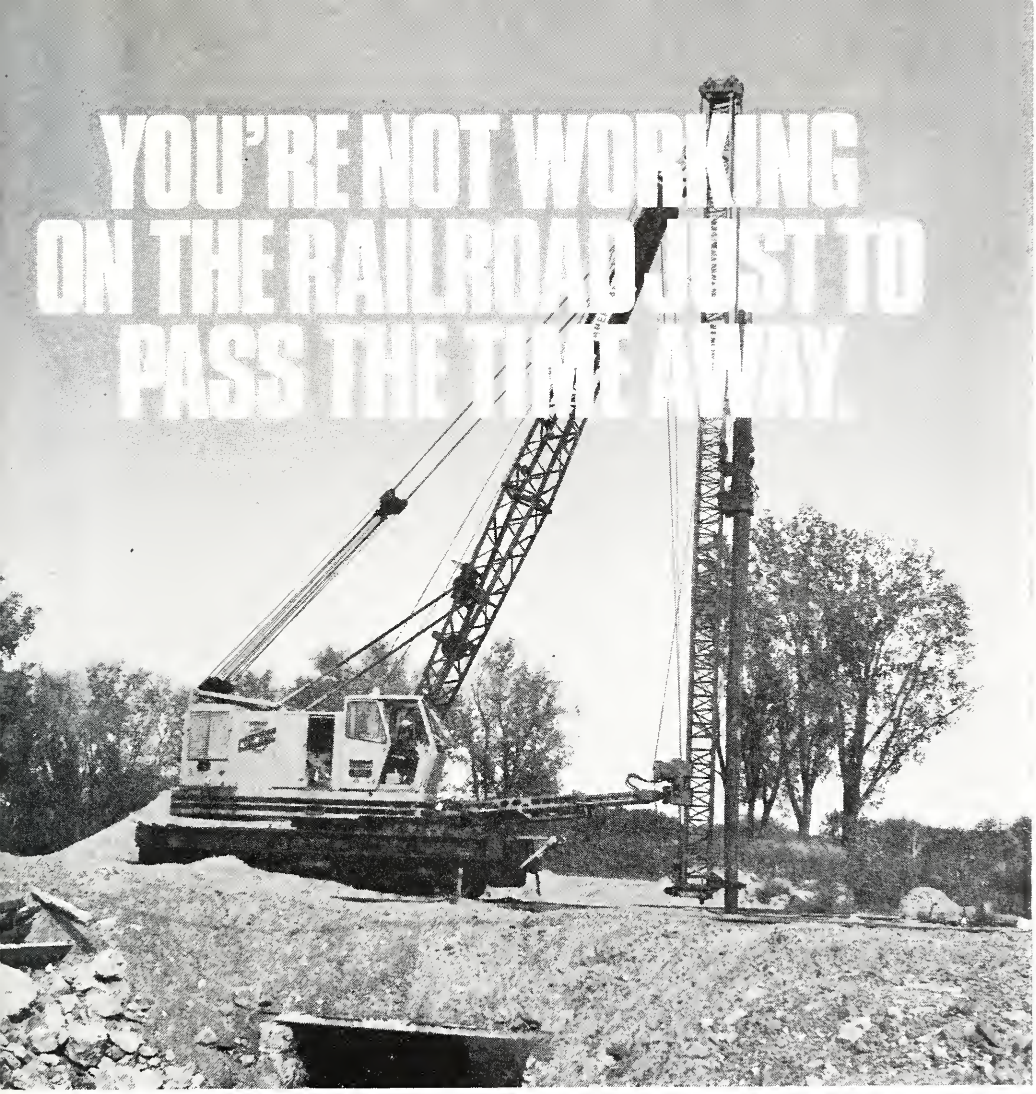

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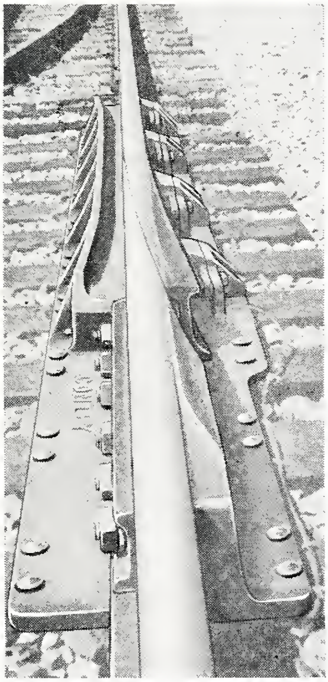

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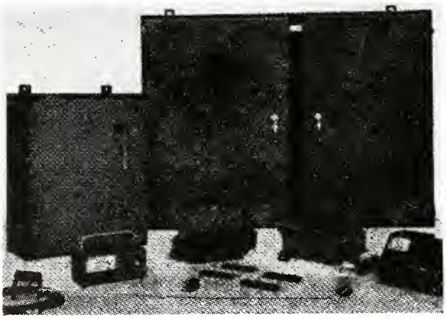

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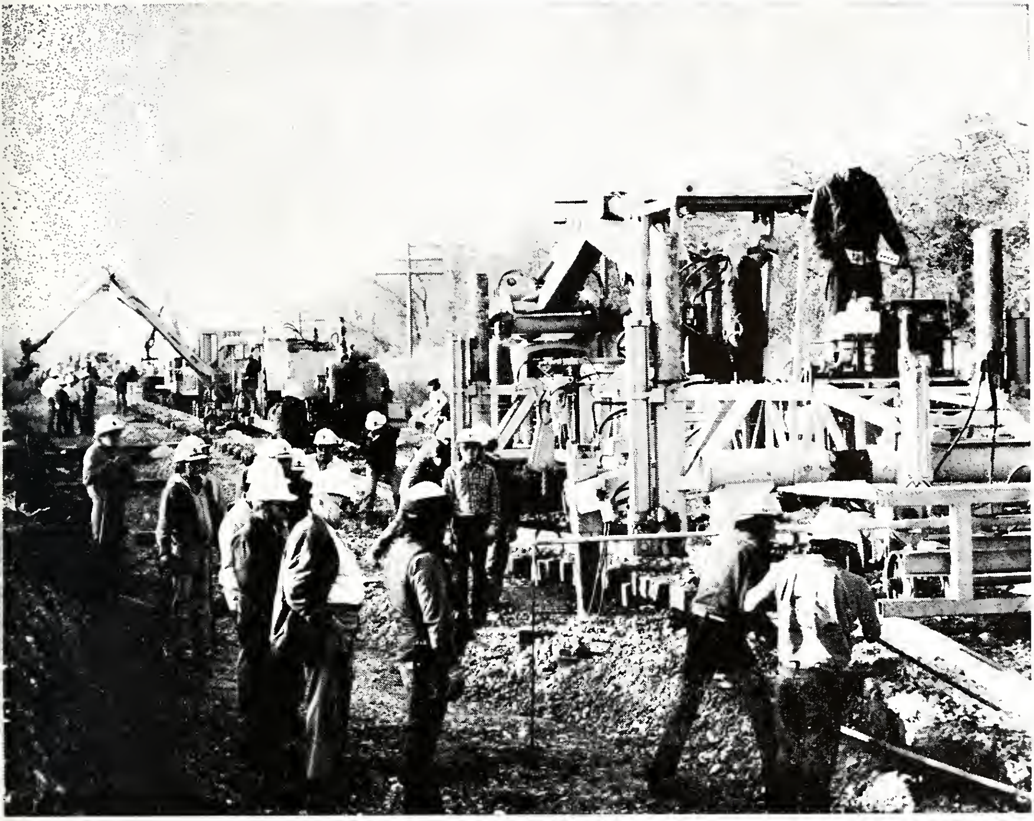

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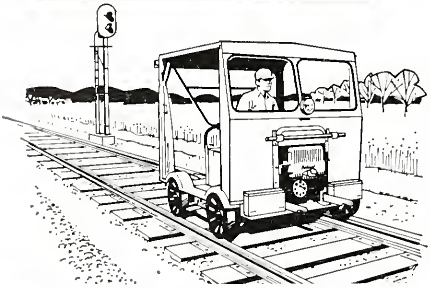

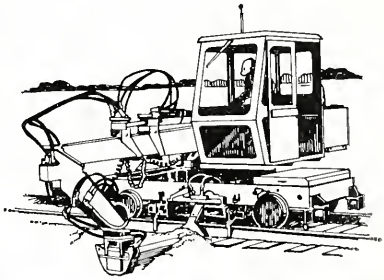

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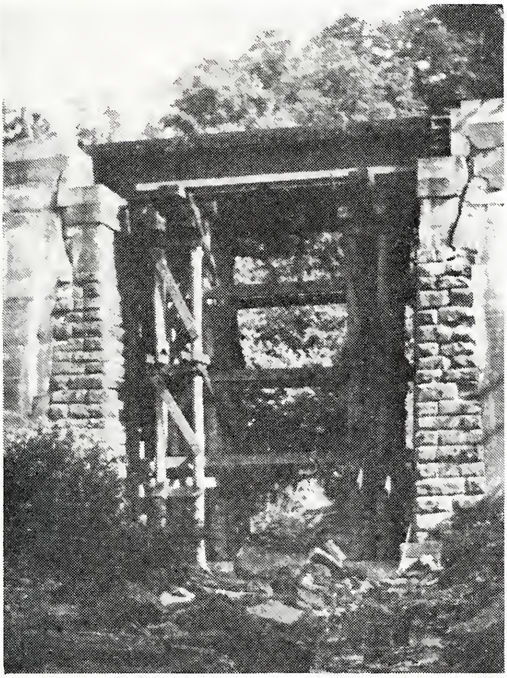

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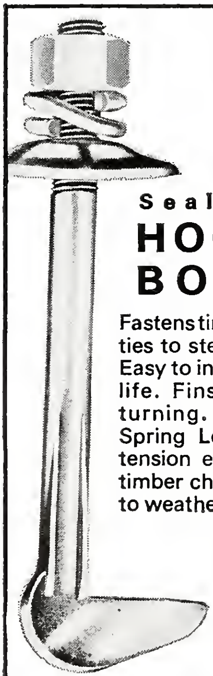

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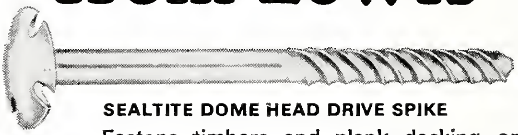

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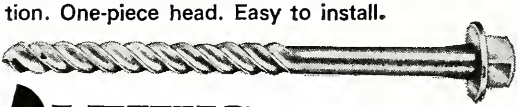

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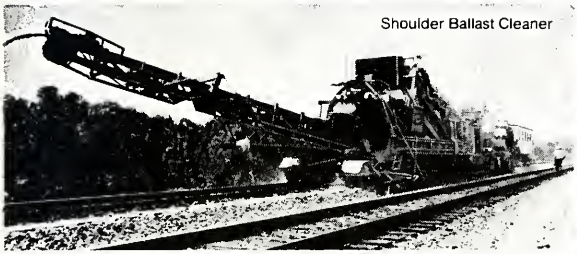

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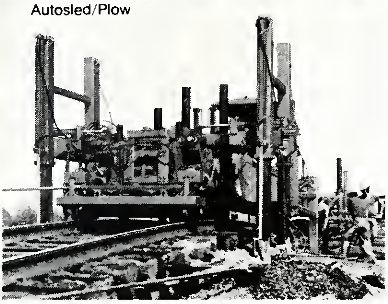

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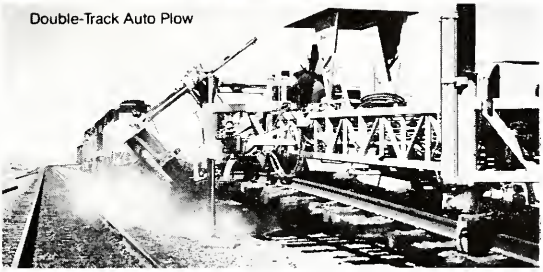

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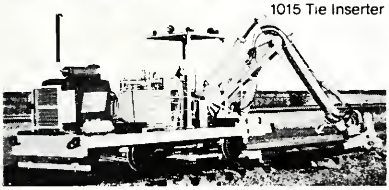

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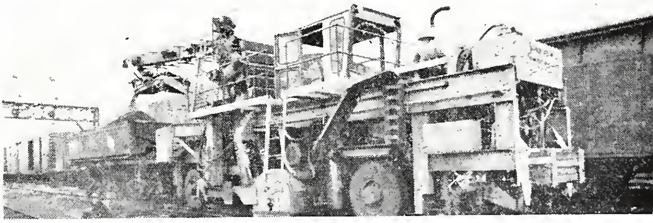

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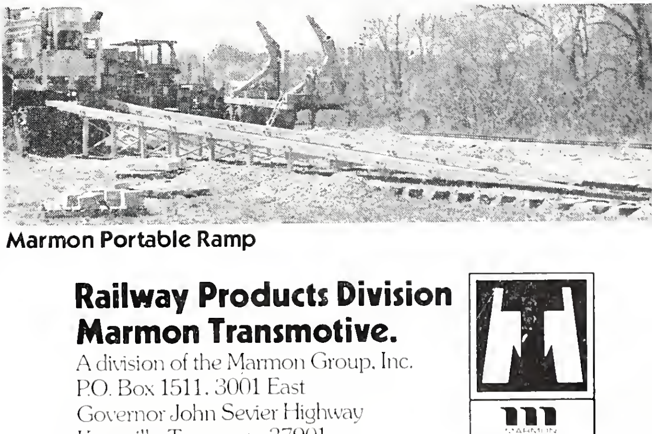

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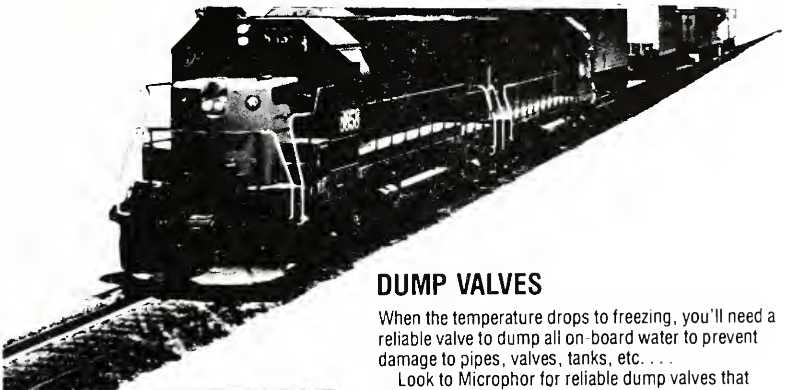

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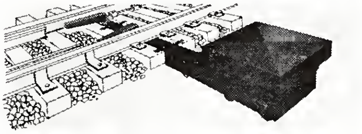

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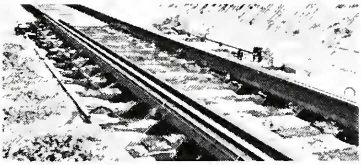

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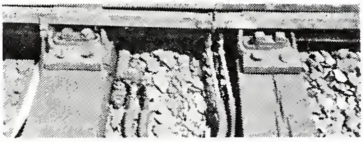

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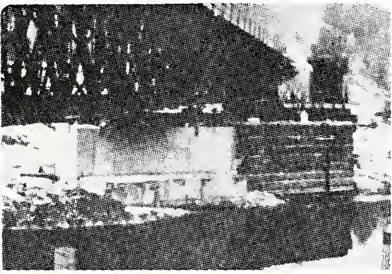
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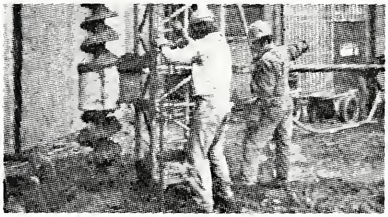

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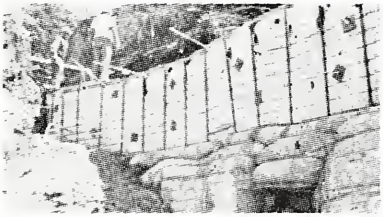

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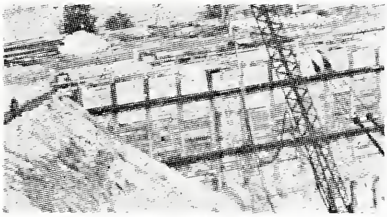

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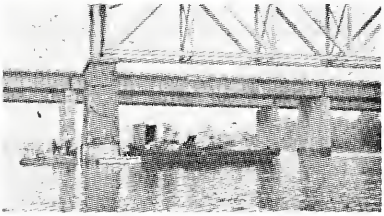

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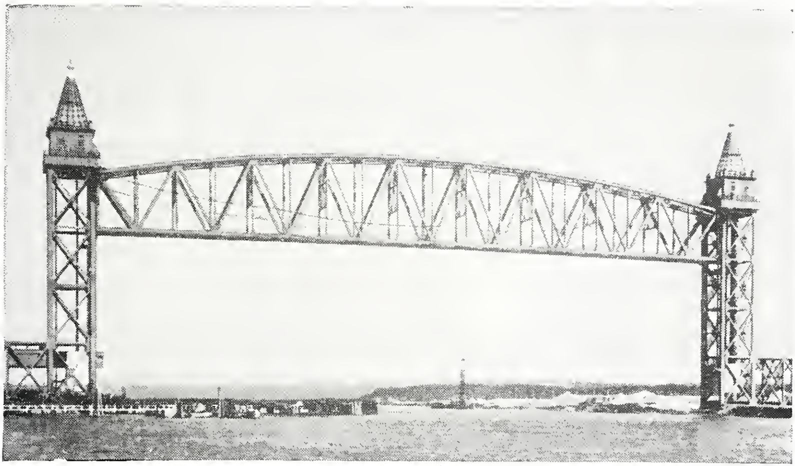

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